Research

Impact of Brief Motivational Interviewing on Periodontal Clinical Outcomes: A randomized clinical trial

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Abstract

Purpose: Patient education and oral hygiene instruction (OHI) communication play a key role in the dental hygiene process of care. The purpose of this study was to determine whether brief motivational interviewing (BMI) was superior to traditional OHI in improving periodontal health. Chairside time needed to deliver traditional OHI as compared to BMI was also compared.

Methods: A convenience sample of 60 participants were randomized into two groups. The control group received traditional OHI and the test group received BMI. Periodontal indicators of disease were collected by a blinded examiner. Interventions for both groups and data collection occurred at four time points over a 12-month period. Periodontal outcome measures were plaque score, bleeding on probing (BOP), and gingival index (GI).

Results: Both groups showed significant reductions in plaque score, BOP, and GI over time. The control group had an improvement in plaque score compared to the test group at visit three ($p=0.05$) and at visit four ($p=0.03$). The test group had an improvement in GI score compared to the control group at visit four ($p=0.03$). Chairside time was shorter in the control (OHI) group at each time point ($p<0.01$).

Conclusion: Both traditional OHI and BMI patient education communication methods improved periodontal outcomes measured by plaque score, BOP, and GI. The inclusion of BMI in patient education sessions was demonstrated to be feasible within the time constraints of the dental hygiene recare appointment.

Keywords: motivational interviewing, brief motivational interviewing, oral hygiene instruction, patient education

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Introduction

Patient education and oral hygiene instruction (OHI) communication play an instrumental role in the dental hygiene process of care and assisting patients in achieving optimal oral health. Historically, advice giving methods, known as tell-show-do, have been used to provide patient education and OHI. Advice giving methods have not been shown to be supportive of patient autonomy or behavior change to improve an individual's oral hygiene.[1–3] These methods of patient education and OHI have been shown to serve the agenda of the oral healthcare provider rather than the individual's interests as they relate to their long-term oral health goals. Evidence-based research indicates advice giving methods or fear tactics are ineffective and have not been shown to sustain long-term positive behaviors.[1,2]

Motivational interviewing (MI) is a patient-centered, collaborative counseling approach to strengthen an individual's intrinsic motivation towards a positive behavior change.[3] Practicing MI encompasses an understanding. Motivational interviewing is not a technique, but a philosophy which has been described as the "Spirit of MI."[3,4] This evidence-based approach allows a provider to foster partnership with another individual by conveying the four integrated components of the "Spirit of MI" partnership, acceptance, compassion, and evocation to support behavior change.[3] The goal of MI is to develop patient-provider trust and rapport to evoke a positive behavior change by collaborating and supporting an individual's intrinsic motivation.[3] Motivational interviewing has been well

documented as a successful counseling method for chemical dependency, alcoholism, obesity, diabetes management, and tobacco cessation dating back to the 1980's.[5–8] Furthermore, MI is adaptable for a variety of health professionals to provide patient-centered counseling and support a positive health behavior change.[7]

Patient-centered care and competence implementing effective communication skills are described in the Commission on Dental Accreditation (CODA) Standards 2-12 and 2-13.[9] Thus, the incorporation of evidenced-based counseling methods such as MI in dental hygiene curricula to support patient-centered care is essential. Studies have explored MI training including coaching and feedback for both dental hygiene faculty and students.[2,10–12] In addition, randomized clinical trials have investigated the impact of MI strategies to improve oral health among children, adults, and vulnerable populations.[1,13–17] However, the efficacy of MI, discrepancies in the duration and number of sessions to support a positive oral health behavior change, and time constraints have been reported in the literature.[1,11,12,16–19]

These challenges of implementing MI during patient care may be eliminated or dramatically reduced by utilizing a brief motivational interviewing (BMI) technique during continuous care appointments. Brief motivational interviewing is intended for health professionals with limited time (five to ten minutes) to support a behavior change during patient care appointments.[20,21] Brief motivational interviewing encompasses the collaborative "Spirit of MI" to evoke a patient's intrinsic motivation by asking permission and establishing rapport.[20–22] Further, the utilization of BMI during sequential dental hygiene care appointments may support provider-patient partnerships to develop collaboration, acceptance, compassion, and evocation long-term.[3,20] Dental hygienists who have routine patient encounters of approximately 2-4 times annually, have the opportunity to implement BMI as a means to build upon and support a patient's oral health goals.[20–22]

BMI and Periodontal Outcome Measures

To date, three studies have investigated the implementation of MI for improved periodontal clinical outcome measures.[1,15,19] Jonsson et al. reported clinical improvements in plaque index (PI) and gingival index (GI) over a two-year period using two experimental case studies.[19] While Jonsson et al. reported that the MI intervention was time consuming, it was hypothesized that improved periodontal clinical outcomes may be sustained with frequent provider encounters with MI counseling.[19] The Jonsson et al. study provided baseline evidence to test MI in larger scale clinical trials to determine the

impact on behavior change for improved periodontal clinical outcome measures. In 2009, Almomani et al. concluded an 8-week randomized clinical trial and identified statistical significant improvement in PI in the MI group as compared to the control group.[15] Limitations reported in this clinical trial were lack of follow-up to evaluate if the reduced PI was maintained.[15] Additionally, the MI group had more provider encounters compared to the control group which may have impacted periodontal clinical outcomes.[15]

A single blinded, randomized controlled trial by Brand et al. compared a single MI session to traditional oral hygiene education.[1] Participants were randomly assigned to either the BMI group or the traditional oral health education group.[1] The BMI group attended one MI session approximately 15-20 minutes long with a trained MI counselor who was not a dental professional.[1] The traditional oral health education group received information on areas that needed improvement and shown how to improve these areas with oral hygiene aids (tell-show-do method).[1] Clinical measurements included PI, bleeding on probing (BOP), and GI.[1] There was no significant findings demonstrating that a single MI session showed improved clinical outcomes compared to traditional oral hygiene education, indicating that multiple BMI sessions may be needed to support a patient's behavior as measured by indicators of periodontal disease.[1]

Dental hygienists trained in MI may have a unique opportunity to support a patient's positive health behavior change to improve periodontal conditions during continuing care appointments. Dental hygienists have the availability to provide ongoing education and MI counseling 2-4 times annually during a typical 45 to 60 minute dental hygiene appointment. The frequency of provider-patient encounters supports the inclusion of BMI as the most effective method to build upon goals in a collaborative partnership to improve oral health.[20–22] The utilization of BMI during dental hygiene care appointments may sustain long-term oral health and general health. Additionally, the application of BMI during recurring appointments supports the "Spirit of MI" for long-term provider-patient partnerships.

The effectiveness of multiple BMI sessions to reduce plaque score, BOP, and GI, as compared to traditional OHI during continuing care appointments with a dental hygiene provider has not been reported in the literature. The purpose of this study was to determine whether the use of BMI is more effective than traditional OHI in reducing patients' plaque score, BOP, and GI over the course of 12 months. A secondary purpose was to determine the amount of time needed to deliver traditional OHI as compared to BMI.

Methods

A single-site, randomized, examiner-blinded clinical trial (STUDY00003697) was approved by the University of Minnesota (UMN) Institutional Review Board (IRB) and registered with ClinicalTrials.gov (NCT03571958). A convenience sample of eligible participants in the periodontal maintenance phase of treatment at the UMN School of Dentistry (SOD) were recruited from September 2018 to August 2019 to participate. A power analysis determined 30 participants per group had 80% power to detect an effect size of 0.74, using a two-group t-test at the 0.05 level of significance. Clinical research visits were scheduled from September 2018 until September 2020. The UMN paused all human research in March 2020 due to the COVID-19 pandemic. This study was approved as an "essential study" to continue in person visits for enrolled participants. In April 2020 an IRB modification of the original submission to mitigate risk of transmission of COVID-19 was approved.

Patient charts were pre-screened for inclusion criteria (Table I) in the dental management software program (axiUm, Exan; Las Vegas, NV, USA). Participants who met the inclusion criteria were mailed an invitation letter. Additionally, recruitment fliers with clinical trial key inclusion criteria were posted on each floor of the UMN SOD. A total of 184 charts were pre-screened based on responses to the invitation letter or from inquiries guided by the recruitment flier. Following a pre-screening phone call, a total of 65 candidates were deemed eligible for a screening visit. Potential participants were screened by the principal investigator. Participants meeting the inclusion criteria were enrolled in the study. All participants had the option to opt out of participation anytime during the study.

Enrolled participants were randomized using a statistical software program (SPSS; IBM, Armonk, NY, USA) to either the control (traditional OHI) or test (BMI) group. Participants in both groups received periodontal maintenance care appointments and primary clinical outcomes were collected at four time points over a one-year period in the UMN SOD Oral Health Clinical Research Center (OHCRC). The clinical outcomes of plaque score, BOP, and GI were collected at four time points by the same single-blinded examiner (YR). The time points were visit one (V1) baseline collection, visit two (V2) 4-month recall +/- one month from V1, visit three (V3) 8-month recall +/- one month from V1, and visit four (V4) 12-month recall +/- one month from V1. The examiner was an experienced licensed dental hygienist and the dental hygiene clinical director at the UMN SOD. Plaque scores were measured utilizing O'Leary plaque score.[23] Bleeding on probing was measured as a dichotomic presence or absence of bleeding 15 seconds after probing. The gingival index was measured utilizing the Löe gingival index system (0, 1, 2, or 3).[24] After clinical outcomes were collected by the blinded examiner (YR), the principal investigator (MA) facilitated the control and test group assigned OHI and BMI sessions and performed periodontal maintenance care.

Table I. Inclusion, Exclusion, Premature Exclusion and Participant Withdrawal

Inclusion Criteria
Male or Female
≥ 18 years old
Periodontal maintenance phase (at least one year)
Plaque score ≥30% (O'Leary plaque score)
Minimum of two sites with BOP
Willingness to fulfill all study requirements
Patient of record at the UMN School of Dentistry

Exclusion Criteria
Current smoker or quit smoking less than one year
Pregnant, planning to become pregnant, or unsure of pregnancy status (self-reported)
Poorly controlled diabetes (HbA1C > 7)
Medical conditions that may influence the outcome of the study (neurologic or psychiatric disorders, systemic infections, cancer, and/or HIV/AIDS)
Current use of oral bisphosphonates or history of intravenous bisphosphonates
Requires pre-medication or on long-term antibiotics
Current orthodontic treatment or planning to begin orthodontic treatment during the study
Unable to comply with the study protocol

Premature Exclusion Criteria/ Participant Withdrawal
Researcher believes it is not the individual's best interest to remain in the study
Participant becomes ineligible to participate based on the exclusion criteria
Participant's medical condition requires interventions which preclude involvement in the study (examples: radiation therapy, chemotherapy, or pre-medication)
Participant does not follow study related instructions
Study suspension or cancellation
Numerous missed, canceled, or broken research visits

Control and test group OHI sessions were audio recorded. The control group received traditional OHI (tell-show-do) customized to their plaque score, BOP, and GI. The test group received OHI utilizing BMI strategies customized to their interest to reduce their plaque score, BOP, and GI. The BMI participants were asked two standardized open-ended questions to gauge their interest in their plaque score and ask permission to proceed. The principal investigator was a licensed dental hygienist and dental hygiene educator with extensive MI experience that included a 2-day training course with a motivational interviewing treatment integrity (MITI) MI trainer.

Recorded test (BMI) group OHI sessions were coded for global scores and modified behavior counts using the MI treatment integrity coding manual (MITI 4.2.1) by two calibrated MI trained study team members (CB and LA) to confirm MI fidelity in this study.[25] Behavior counts were modified to only include open questions, affirmations, reflections, and summaries (OARS), importance/confidence ruler, give information with permission, and emphasizing autonomy for the MI intervention. Operational definitions are provided in Table II.

Table II. Modified Behavior Counts[*]

Open-ended questions: A question that cannot be answered with a "yes" or "no" response.
Affirmations: Giving encouragement or praise for the participant's strengths.
Reflective listening: Listening to understand the participant's perceptions and ambivalence.
Summarizing: To close the MI session or to restate (in the study team members own words) the information provided by the participant. This will confirm the study team member was listening and understands the participant's perspective.
Importance/confidence ruler (readiness ruler): Tool to identify the participant's readiness to change/ level of importance or confidence on a scale 0-10.
Give information with permission: Elicit information to the patient when permission is granted and /or during a collaborated effort of the clinician to answer a participant's question.
Emphasizing autonomy: Supporting the participant's right to make a decision or choose without persuasion.

[*]Modified with permission: Moyers TB, Manuel JK, Ernst D. Motivational interviewing treatment integrity coding manual 4.2.1. Unpublished manual; revised June 2015. 40 p.

Statistical Analysis

Demographic characteristics are summarized using counts and rates or means and standard deviations. Plaque scores, BOP, and GI scores at each visit were calculated for each participant as their mean score across all teeth and sites. Plaque, BOP, and GI scores and minutes of chairside time were each compared between groups and between visits within groups using mixed-effects linear models with fixed effects for group, visit, and group-by-visit interaction, and a random effect for participant to account for correlation within participants across visits. Similar mixed effects models with the V2-V4 measures as the outcome and the V1 measure as a covariate were used to obtain baseline-adjusted comparisons between groups at the post-baseline visits. Analyses were performed using a statistical software program (R version 4.0.3; https://cran.r-project.org).

Results

A total of 60 participants were eligible to participate and 58 completed all study visits (97%). Retention of test participants was 100% (n=27) and retention of control participants was 94% (n=31). To maintain 80% power, the detectable effect size increases by 2% for the original. Two participants from the control group withdrew from the study during the COVID-19 pandemic. A flowchart of the study progression is shown in Figure 1. Data collection for V1 and V2 for all 58 participants were within the study protocol timeframe. The pause in clinical research due to COVID-19 resulted in data collection for V3 and V4 taking place outside the protocol time frame for 21 participants (test n=11; control n= 10).

The average age of the participants was >60 years. The control group had more male participants (n=21) compared to female participants (n=10). The gender ratio in the test group was similar (n=13 male; n=14 female). Most of the participants reported their ethnicity as White (n=30, 96.8% control; n=24, 88.9%, test). Only one participant identified as Black/African American (n=1, 3.2%, control) while two identified as Asian/ Pacific Islander (n=2, 7.4%, test). Participant demographics are shown in Table III.

Mean plaque scores for the test group were 53.2 (V1), 47.0 (V2), 40.9 (V3), and 41.4 (V4). The control group had similar mean plaque scores 50.4 (V1), 40.5 (V2), 33.1 (V3), and 32.9 (V4). The control group had lower plaque scores than the test group at V3 (p=0.05) and V4 (p=0.03) when controlling for the V1 plaque score. Plaque score from the participants not impacted by the pause in clinical research due to COVID-19 (n=37) did not yield statistical significance between groups (V2 p=0.16, V3 p=0.26, and V4 p=0.16). Plaque scores within
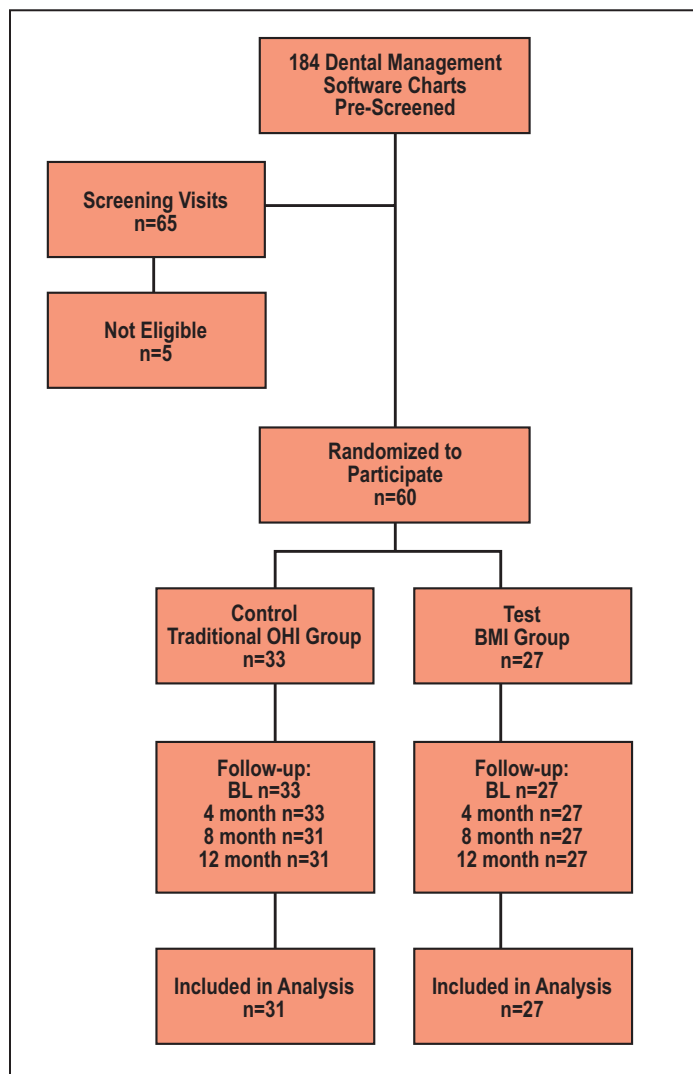
Figure I. Flowchart for Recruitment and Retention

Table III. Demographics

Category	Control=31 n %	Test=27 n %
Age Mean ± SD*	**63.78 (10.32)**	**61.93 (10.08)**
Gender n (%)		
Male	21 (67.7)	13 (48.1)
Female	10 (32.3)	14 (51.9)
Ethnicity n (%)		
White	30 (96.8)	24 (88.9)
Black/African American	1 (3.2)	0 (0.0)
Hispanic/Latino	0 (0.0)	0 (0.0)
Native American/ American Indian	0 (0.0)	0 (0.0)
Asian/Pacific Islander	0 (0.0)	2 (7.4)
Other	0 (0.0)	1 (3.7)
Highest Level of Education n (%)		
Some High School	0 (0.0)	0 (0.0)
Graduated High School	1 (3.2)	0 (0.0)
Some College	7 (22.6)	8 (29.6)
Associates Degree	7 (22.6)	3 (11.1)
Bachelor Degree	7 (22.6)	9 (33.3)
Master Degree	9 (29.0)	5 (18.5)
Doctorate Degree	0 (0.0)	2 (7.4)

*Age mean +/- Standard Deviation (SD)

each group did yield statistical significance when compared to baseline scores (V2 $p=0.05$, V3 $p<0.01$, V4 $p<0.01$; test group) (V2 $p<0.01$, V3 $p<0.01$, V4 $p<0.01$; control group) (Table IV).

Mean BOP scores for the test group were: 0.134 (V1), 0.089 (V2), 0.081(V3), and 0.073 (V4). The control group had similar mean BOP scores: 0.135 (V1), 0.069 (V2), 0.076 (V3), and 0.057 (V4). Test and control groups did not differ at V2, V3, or V4 for all participants or for the participants not impacted by the pause in clinical research due to COVID-19. Bleeding on probing within each group yielded statistical significance when compared to baseline (V2 $p=0.01$, V3 $p=0.01$, V4 $p=0.01$; test group) (V3 $p=0.01$, V3 $p=0.01$, V4 $p=0.01$; control group) (Table IV).

Mean GI scores for the test group were 1.027 (V1), 0.847 (V2), 0.719 (V3), and 0.553 (V4), while the control group scores were: 0.990 (V1), 0.848 (V2), 0.819 (V3), and

0.714 (V4). The test group had a statistically significant improvement in GI score at V4 ($p=0.03$) for all participants and those participants not impacted by the pause in clinical research due to COVID-19 ($p=0.04$). The gingival index within each group demonstrated improvement at each visit as compared to baseline (V2 $p=0.01$, V3 $p<0.01$, V4 $p<0.01$; test group) (V2 $p=0.06$, V3 $p=0.02$, V4 $p<0.01$; control group). A complete display of the primary outcome measures, longitudinal estimates and comparisons of plaque score, BOP, and GI is shown in Table IV.

Chairside time spent in minutes on patient education for both groups is provided in Table V. Mean BMI (test group) times were 10.8 (V1), 10.5 (V2), 8.6 (V3), and 11.8 (V4) minutes and 5.9 (V1), 6.0 (V2), 5.6 (V3), and 5.6 (V4) minutes for the OHI (control group). The control group sessions were shorter at each visit ($p<0.01$).

Table IV. Primary Outcome Measures: Longitudinal estimates and comparisons

Primary Outcome Measures	Estimates	Visit	Mean	Lower CI	Upper CI
O'Leary Plaque Score	Test	1	53.2	47.7	58.8
		2	47.0	41.4	52.6
		3	40.9	35.3	46.4
		4	41.4	35.8	46.9
	Control	1	50.4	45.0	55.8
		2	40.5	35.1	45.9
		3	33.1	27.7	38.5
		4	32.9	27.5	38.3
	Comparisons‡	Visit	Estimate	SE	p-value
	Test vs. Control (n=58) †	2	-5.30	3.36	0.11
		3	-6.52	3.36	0.05*
		4	-7.22	3.36	0.03*
	Test vs. Control (n=37) ††	2	-6.59	4.65	0.16
		3	-5.23	4.65	0.26
		4	-6.61	4.65	0.16
	Test Only (n=27)	2 vs 1	-6.25	2.64	0.05*
		3 vs 1	-12.39	2.64	<0.01*
		4 vs 1	-11.89	2.64	<0.01*
	Control Only (n=31)	2 vs 1	-9.90	2.55	<0.01*
		3 vs 1	-17.27	2.55	<0.01*
		4 vs 1	-17.47	2.55	<0.01*

Primary Outcome Measures	Estimates	Visit	Mean	Lower CI	Upper CI
BOP Scores	Test	1	0.134	0.102	0.166
		2	0.089	0.057	0.121
		3	0.081	0.049	0.113
		4	0.073	0.041	0.104
	Control	1	0.135	0.104	0.166
		2	0.069	0.038	0.100
		3	0.076	0.046	0.107
		4	0.057	0.026	0.088
	Comparisons‡	Visit	Estimate	SE	p-value
	Test vs. Control (n=58) †	2	-0.0205	0.0145	0.16
		3	-0.00490	0.0145	0.73
		4	-0.0160	0.0145	0.27
	Test vs. Control (n=37) ††	2	-0.0087	0.0157	0.58
		3	-0.0079	0.0157	0.61
		4	-0.0001	0.0157	0.99
	Test Only (n=27)	2 vs 1	-0.0450	0.0119	<0.01*
		3 vs 1	-0.0532	0.0119	<0.01*
		4 vs 1	-0.0610	0.0119	<0.01*
	Control Only (n=31)	2 vs 1	-0.0658	0.0115	<0.01*
		3 vs 1	-0.0583	0.0115	<0.01*
		4 vs 1	-0.0778	0.0115	<0.01*

‡ Adjusted for visit 1

† All participants (n=58) = A total of 20 participants data collection was outside of the protocol window due to the pause in clinical research due to COVID-19

†† Participants not impacted by the pause in clinical research due to COVID-19 (n=37); Confidence Interval (CI) 0.95; Standard Error (SE); statistical significance* ≤0.05

Discussion

Results from this randomized clinical trial supported the primary hypothesis that multiple BMI sessions with a trained MI dental hygiene provider would yield improved periodontal health. The BMI test group demonstrated statistically significant improvement in gingival health as measured by the GI. There were statistically significant reductions of plaque score and BOP was observed within both groups. However, there was no significance when comparing groups. In the current study, the O'Leary plaque score was used to provide participants with a percentage of plaque and categories of excellent, good, fair, and poor hygiene.[23] Previous MI studies used the plaque index. The decision to use O'Leary plaque score instead of PI

used in previous MI studies [1,15,19] was not shown to impact the periodontal outcomes in this study.

The traditional OHI (tell-show-do) group demonstrated reduced plaque scores at V3 and V4. These may have occurred because participants were not blinded to their assigned group. The control group was instructed to follow specific home care behaviors to reduce their plaque score as part of the study requirements. The test group received BMI that encompassed the "Spirit of MI", supporting patient autonomy and compassion for one's ambivalence to change a behavior or to choose not to change. One of the exclusion criteria of this study was not following the study related instructions (Table I). Although it was explained to all participants that

Primary Outcome Measures	Estimates	Visit	Mean	Lower CI	Upper CI
Gingival Index	Test	1	1.027	0.900	1.154
		2	0.847	0.720	0.974
		3	0.719	0.719	0.846
		4	0.553	0.426	0.680
	Control	1	0.990	0.867	1.113
		2	0.848	0.725	0.970
		3	0.819	0.696	0.846
		4	0.714	0.591	0.680
	Comparisons‡	Visit	Estimate	SE	p-value
	Test vs. Control (n=58) †	2	0.0353	0.0886	0.69
		3	0.1349	0.0886	0.13
		4	0.1958	0.0886	0.03*
	Test vs. Control (n=37) ††	2	0.0770	0.1085	0.48
		3	0.0804	0.1085	0.46
		4	0.2268	0.1085	0.04*
	Test Only (n=27)	2 vs 1	-0.180	0.0637	0.01*
		3 vs 1	-0.308	0.0637	<0.01*
		4 vs 1	-0.474	0.0637	<0.01*
	Control Only (n=31)	2 vs 1	0.142	0.0615	0.06
		3 vs 1	-0.171	0.0615	0.02*
		4 vs 1	-0.276	0.0615	<0.01*

Table V. Chairside Time (Minutes)

Longitudinal Outcomes	Visit	Mean	Lower CI*	Upper CI
Estimates				
Test	1	10.78	9.20	12.36
	2	10.51	8.94	12.09
	3	8.55	6.97	10.13
	4	11.80	10.22	13.38
Control	1	5.90	4.43	7.37
	2	6.00	4.53	7.47
	3	5.64	4.17	7.12
	4	5.62	4.11	7.13
Comparisons	Visit	Estimate	SE (df)	p-value
Test vs. Control	1	-4.88	1.09 (178)	<0.01**
	2	-4.51	1.09 (178)	<0.01**
	3	-2.91	1.09 (178)	<0.01**
	4	-6.18	1.11 (181)	<0.01**

* Confidence Interval (CI) 0.95; Standard Error (SE)
** $p \leq 0.05$

this requirement was in regard to missed research visits for data collection, control group participants may have interpreted that if they did not follow the OHI to reduce their plaque score that they would be excluded from the study. Whereas the test group may not have shared this perception. The test group received instructions in the "Spirit of MI" and if their oral hygiene behaviors were not changed, they were supported by the MI principal investigator and their ambivalence for change was discussed. Participants in the control group may have demonstrated increased compliance because it has been previously reported that demonstration and reinforcement of home care instructions (tell-show-do) can result in improved oral health outcomes.[26]

Clinical outcomes of an MI intervention has been mixed in the literature.[1,13–17,19] Perhaps current MI research has focused too much on achieving statistical significant outcomes to demonstrate that it is the superior communication approach. Instead, dental hygienists should be equipped with multiple communication approaches and skills be able to identify the approach that is best suited for the individual patient with the goal of reducing indicators of periodontal disease. This recommendation for communication skills aligns with the Triple Aim that was developed by the Institute of Healthcare Improvement to meet three goals: 1) improve the patient experience, 2) improve the health of populations, and 3) reduce cost.[27] In this study, the periodontal health of both groups was improved by reducing their plaque score, BOP, and GI. Inclusion of effective communication strategies may lead to improved patient experiences, achieving positive periodontal health outcomes and reduction of long-term costs if patients can maintain effective self-care.

Bleeding on probing showed no difference between groups, but decreased over each time point, which aligns with previous MI clinical trials.[1,19] This finding was expected given that the plaque score decreased overtime in each group. The reduction of BOP in both groups indicates regular periodontal maintenance with OHI delivered via a traditional mechanism or by applying BMI strategies led to improved periodontal

outcomes. Although this reduction was not statistically significant between groups, it held clinical significance for disease progression for participants in this study. According to Lang et al., BOP is the most "useful prognostic indicator" of periodontal disease activity.[28] Therefore, any reduction of BOP is a positive clinical finding and indicative to slowing the progression of periodontitis.

The test group demonstrated a statistically significant improvement in GI as compared to the control group. Clinical observations of reduced inflammation as measured by GI was achieved with test participants across all time points. It was noteworthy that BOP outcomes in this study did not correspond to GI outcomes. This finding may be explained by Benamghar et al. who identified that "bleeding can occur independently of edema."[29] Further, BOP may be attributed to genetic susceptibility, regardless of GI score.[29] This finding may indicate why BMI may be a superior strategy to reduce periodontal inflammation as measured by GI over time versus traditional OHI approaches. However, more research is needed to determine which approach is more effective for patients with a predisposition for periodontal disease as measured by increased BOP.

Unique to this study was the pause in clinical research due to COVID-19. Of the participants who were not impacted by the research pause (n= 37), there were no differences in plaque scores or BOP between the groups. These findings were similar to Brand et al. who reported no differences between groups in PI or BOP over a one-year period; however, there was a statistical improvement of GI for test participants by the conclusion of the study.[1] Brand et al. suggested the lack in differential periodontal outcomes may be indicative of no changes in patient motivation.[1] In the current study, statistical significance to reduce plaque score, BOP, and GI was achieved within both the test and control groups. It may have been an expected finding for the control group because they were instructed to perform specific oral hygiene behaviors as part of their research group. Whereas the test group had the choice whether to perform the oral hygiene behaviors. The improved plaque scores, BOP, and GI over time within each group may be indicative of patient motivation. Ribeiro et al. reported the delivery method of patient education had no impact on plaque and GI; rather the repeated reinforcement and motivation strategies produced improved outcomes.[30] This is valuable information in affirming the role of a dental hygienist in providing education and OHI, regardless of the delivery method.

Both traditional OHI (tell-show-do) and BMI approaches may have motivated participants as a result of the continuous patient education opportunities over the duration of the study; both methods were associated with improved periodontal health. Perhaps the patient experience described in the Triple Aim influenced the positive outcomes in both groups.[27] Patients at the UMN SOD were accustomed to receiving dental care from different student providers for one or more procedures. The inconsistency of multiple providers may have impacted the "patient experience," consequently impacting patient compliance.[27] Participants in both groups had direct contact with the same principal investigator and blinded-examiner every 3-4 months for continuing care visits over 12 months. Trust and rapport, the foundation of the "Spirit of MI" may have developed with participants of both the test and control groups.[3] All encounters were with skilled DH faculty, which may have enhanced the patient experience and influenced the participants'motivation. In addition, the patient-provider relationship has been documented as a valuable and key element in patient compliance.[31]

Regarding chairside time, the hypothesis that BMI would take longer compared to traditional OHI approaches was accurate. This was in agreement with previous reports regarding the time constraints to implement BMI during patient care.[1,11,12] The analysis of the chairside time in this study was valuable and the inclusion of BMI during a patient encounter was shown to be attainable.[20,21] Although the traditional OHI approach took less time, implementing BMI produced mean scores ranging from a low of 8.55 minutes to a high of 11.80 minutes. This finding indicates that the MI behavior counts can be implemented, demonstrating the feasibility of the inclusion of BMI within 5-10 minutes during a patient re-care appointment. Dental hygienists interested in applying MI strategies during patient education may want to start with OARS (open questions, affirmations, reflections, and summaries), while following the elicit-provide-elicit technique of "asking permission" to support patient autonomy and the importance ruler to gauge patient perceptions and ambivalence of change. Lastly, Brand et al. stated the "dose" or length and frequency of the MI intervention needs to be explored to determine the minimal number of sessions needed to indicate that BMI is superior to traditional OHI.[1] Findings from this study also support this need.

The study had limitations. The convenience sample of patients in the periodontal phase of treatment at a single midwestern dental school, does not reflect all periodontal patients. Although the recruitment goal was met, more participants could have been enrolled to compensate for attrition. Further, the COVID-19 pandemic was unexpected and the impact of COVID-19 on patient motivation to change behaviors to improve periodontal clinical outcomes

is unknown. Future MI research should include multiple MI-trained dental hygienists to provide patient education and counseling to support positive behavior change.

Conclusion

Results from this study indicate that both traditional OHI and BMI were associated were associated with improved periodontal outcomes as measured by plaque score, BOP, and GI. This study underscores the importance of the patient-provider relationship and patient education for the reduction of clinical markers of periodontal disease. Participants in this study should receive further follow-up care to determine whether the improved periodontal outcomes were sustainable. Four BMI sessions with a trained MI dental provider were associated with improved periodontal outcomes, however further research is needed to determine the number of sessions needed to achieve statistical significance compared to traditional OHI. The inclusion of BMI in patient education sessions was demonstrated to be feasible within the time constraints of the recare appointment.

Disclosure

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