The effect of motivational interviewing based on the transtheoretical model on oral cleaning behavior of patients with periodontitis who have undergone implant restoration

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Abstract.

BACKGROUND: Implant-restored patients with periodontitis have a higher risk of developing peri-implantitis, and helping them develop oral cleaning habits is significant.

OBJECTIVE: To evaluate the effectiveness of motivational interviewing based on the transtheoretical model on the modification of oral cleaning behaviors of implant-restored patients with periodontitis.

METHODS: Patients with periodontitis ($n = 70$) who would receive dental implant treatment were included. And they were randomly divided into two groups: experimental ($n = 35$) and control ($n = 35$). Control patients received routine oral hygiene education, and those in the experimental group received motivational interviewing based on the transtheoretical model. Oral cleaning behavior was compared between the two groups before and after intervention. In addition, periodontal health status was compared on the day of implant restoration and three months later.

RESULTS: Compared to the control, the experimental group demonstrated significantly better oral hygiene behavior after intervention ($P < 0.05$). Three months after implant restoration, significantly better results were obtained by the experimental group in terms of mPLI and mSBI ($P < 0.05$).

CONCLUSION: Motivational interviewing based on the transtheoretical model can effectively improve the oral cleaning behavior and periodontal health of implant-restored patients with periodontitis.

Keywords: Periodontitis, implant, oral cleaning behavior, motivational interviewing based on the transtheoretical model

1. Introduction

Periodontitis is one of the most important causes of dentition defect or missing dentition encountered in clinical practice. Most patients who clinically require dental implant treatment have a history of

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periodontitis. Some studies have shown that implant-retained prosthetics during the stable phase of chronic periodontitis is safe and feasible, because patients with periodontitis can also obtain short-term efficacy similar to that of periodontally healthy subjects through effective health maintenance [1]. Currently, there is consensus that periodontitis is not a clinical contraindication for implant-retained prosthetics; however, peri-implantitis is strongly associated with certain pathogenic bacteria [2] and patients with periodontitis have a higher risk of peri-implantitis than periodontally healthy patients after dental implant restoration [3]. Possible causes are as follows: first, periodontitis is a chronic disease and, even if it is successfully controlled with the help of professionals, if the patient does not place considerable emphasis on daily oral care, the risk of relapse remains very high [4]; second, as with other chronic diseases, to maintain long-term curative effect, periodontitis management requires high compliance of patients in their lifelong health management, including maintenance of good oral cleaning habits and regular revisits. Nevertheless, traditional oral hygiene education has little effect on patient compliance. Although it can urge patients to passively follow clinical direction in the short term, it is difficult to fundamentally reverse poor oral cleaning habits and health management in patients with periodontitis [5]. Therefore, improving patient compliance and helping patients to develop stable habits of personal oral cleanliness and health management is an important focus in management of patients with chronic periodontitis who have undergone implant restoration. Overall, there is a significant need to find a new method to better manage the oral health of patients with periodontitis who have undergone implant restoration.

In recent years, some scholars have attempted to introduce the transtheoretical model (TTM) and motivational interviewing (MI) from the field of psychology into health behavior change applications, such as cardiovascular medicine [6], orthopedic sports medicine [7], and pulmonary medicine [8], among others, and the effects were significant [9]. The TTM, also known as the stages of change model, suggests that health behavior change occurs when individuals move through five stages of readiness: precontemplation, contemplation, preparation, action, and maintenance. For the purpose of behavior change, TTM can determine specific behavior intervention strategies, according to the different needs of patients at various behavioral stages, and adopt different transformation strategies for each stage [10]. MI is a method to guide individuals to recognize and correct psychological barriers related to undesirable behavior from five aspects: relevance, risk, rewards, roadblocks, and repetition [11]. TTM and MI can help patients with chronic diseases improve their compliance and behavior, which finally contributes to promoting favorable outcome and improving quality of life [12,13]. The effects of these two models on unhealthy behavior shifts have been confirmed in numerous ways to date [14]. Further, some scholars have demonstrated that a combination of the TTM and MI can effectively promote improved dietary behaviors among adolescent youth, as well as medication adherence of patients following stroke [15]; however, there have been no reports on the effects of MI based on the TTM on oral cleaning behavior of patients with periodontitis who have undergone implant restoration.

Therefore, in this study, we applied MI based on the TTM to patients with periodontitis who have undergone implant restoration, to explore the effects of this approach on oral health self-management, including oral cleaning behavior change and periodontal status of dental implants. Our research has potential to enrich the theoretical basis underlying clinical application of MI based on the TTM and help patients with periodontitis who have undergone implant restoration to obtain long-term and stable therapeutic effects.

2. Materials and methods

2.1. Study participants

The Department of Dentistry of Nanfang Hospital, Southern Medical University conducted this study between December 2018 and January 2022. The Ethics Committee of Nanfang Hospital, Southern Medical University approved the research.

And the study involved 70 patients with periodontitis proposed for implant restoration. Every individual signed an informed consent form. And then they were randomly divided into control ($n = 35$) and experimental ($n = 35$) groups.

2.2. Inclusion and exclusion criteria

Patients with periodontitis who meet the indication of dental implant and would accept related therapy were selected. In addition, they also need to be mentally healthy, capable of understanding and signing consent forms, and willing to receive regular follow-up.

The inclusion criteria for patients with periodontitis were as follows: 1) diagnosed with localized chronic periodontitis, according to the Classification of Periodontal Diseases issued by the American Academy of Periodontology in 1999 [16]; 2) periodontitis was controlled by conventional periodontal treatment before oral implant surgery; and 3) the remaining bone mass at the implant site was sufficient, and there was no need for vertical or horizontal bone augmentation procedures.

The exclusion criteria included: 1) patients with psychiatric or systemic disorders that would affect implant surgery; 2) those who did not consent to the study or cooperate with treatment; 3) subjects with smoking, alcohol abuse, or other unhealthy lifestyle habits; 4) patients who were pregnant or lactating; 5) patients complicated with diabetes, osteoporosis, or other related conditions; 6) patients who could not receive the full course of treatment and complete the entire course of follow-up.

2.3. Interventions

Patients in the control group received routine oral hygiene advice during the treatment, including information about perioperative considerations and oral health instructions related to periodontitis and oral implants. Patients in the experimental group received the same routine oral hygiene education as those in the control group plus MI based on the TTM. MI was conducted fortnightly with each interview taking 15–20 min, from the initial visit to 3 months after implant restoration. The specific process and content were as follows: (1) medical and nursing interview groups were established to discuss and develop implementation schemes for MI based on the TTM, and professional training regularly provided for all group members; (2) at first clinic visit, subjects completed open-ended questionnaires to evaluate their willingness to change their oral cleaning behavior, understand their preexisting problems, assess the stage of behavior change patients were in, and the duration and frequency of interview interventions were explained to patients and their families [17,18]; and (3) the stage of behavior change of the patient was assessed through interviews, and patients were provided with information on how to promote health behavior change and improve their ability to achieve oral cleanliness, based on the different behavior stages they were in (details are provided in Fig. 1).

All medical staff involved were uniformly trained before implementation of the study, to ensure consistency of the operation process and mode.

(a)

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        ┌─────────────────────────┐
        │  Assessed for eligibility │
        │        (n=70)           │
        └─────────────────────────┘
                   │
                   │        ┌──────────────────────────────┐
                   ├───────▶│  Excluded  (n=0)             │
                   │        │  No meeting inclusion criteria│
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        ┌─────────────────────────┐
        │   Randomized  (n=70)    │
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Allocated to experimental group (n=35)	Allocation	Allocated to control group (n=35)
Baseline data Oral cleaning behavior	Before implant restoration	Baseline data Oral cleaning behavior
Motivational interviewing based on trans-theoretical model	During the implant restoration period	Routine oral hygiene education
Clinical examination to evaluate periodontal status	The day of implant restoration completed	Clinical examination to evaluate periodontal status
Oral cleaning behavior Clinical examination to evaluate periodontal status	Three months after implant restoration	Oral cleaning behavior Clinical examination to evaluate periodontal status

Analysis

(b)

Precontemplation
Evaluate the stage the patient is in;
Analyze reasons for non-adherence;
Emphasize benefits of oral cleaning;

Contemplation
Reflect on inappropriate behavior;
Inform
consequences of inappropriate behavior;

Preparation
Anticipate *potential* roadblocks;
Make *action* plan *for* change;
Establish a weekly journal of health behaviors;

Action
Inspect regularly;
Adjust intervention measures timely;
Explicit reward and punishment meas*ure*

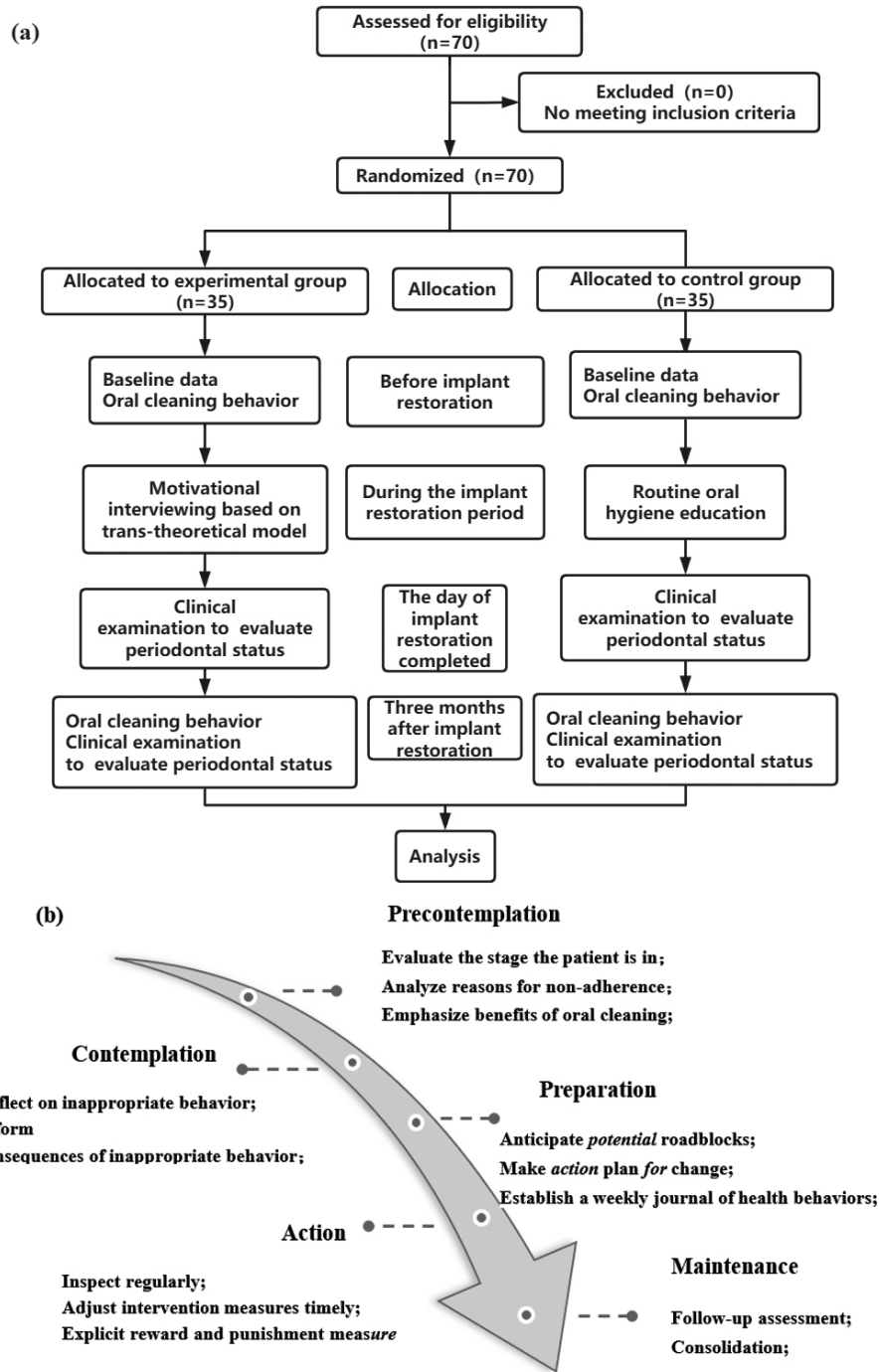**Maintenance**
Follow-up assessment;
Consolidation;

Fig. 1. (a) Flowchart of the study; (b) Specific intervention measures of the motivational interviewing based on transtheoretical model.

2.4. Observation indices

2.4.1. Changes in oral cleaning behavior

An open questionnaire was developed to assess the stage of the oral cleaning behavior of the two groups at first clinic visit and three months after implant restoration. Patients assessed to be in the precontemplation, contemplation, or preparation behavior stages were considered in the first stages of dental cleaning behavior change [17]. Changes in patient oral cleaning behavior were evaluated by comparing differences in numbers of patients in the different behavioral stages before and after the two types of intervention.

2.4.2. Periodontal clinical indices

The periodontal health status of patients was evaluated using the modified plaque index (mPLI), modified bleeding index (mSBI), papilla index score (PIS), and probing depth (PD) on the day of implant restoration and 3 months after implant restoration.

mPLI: Areas around implants were examined using a rigid plastic probe (Click-Probe®, Kerr, Germany) and the mPLI was recorded as follows: 0, no plaque; 1, plaque on the surface of the restoration detected by gentle scratching with the periodontal probe; 2, plaque visible with the naked eye; 3, a large amount of soft debris [19].

mSBI: The probe was use to penetrate the subgingiva 1 mm around the implant and slid parallel to the implant along the buccal-lingual gingival margin, followed by waiting for 30 s. mSBI was then rated as follows: 0, no bleeding; 1, spotted bleeding; 2, linear bleeding in the gingival sulcus; 3, severe bleeding [20].

PIS: Gingival papilla height around the implant was measured and scored as: 0, no papilla; 1, less than half of the papilla; 2, at least half of the papilla; 3, papilla fills up the entire approximal space; 4, hyperplastic papilla [21].

PD: The probe was placed at six sites (mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual, and mesio-lingual) around the implant, and along the long axis of the implant, the probe was inserted into the pocket and measured depth from gingival margin to bottom. The average of the six sites was calculated [22].

2.5. Statistical analysis

SPSS 20.0 (IBM, New York, American) was used to analyze all data. Data for categorical variables were expressed as n (%), and data for continuous variables were expressed as mean $\pm$ SD. Quantitative data was compared using the independent sample t-test, and qualitative data was compared using the chi square test. Wilcoxon rank-sum tests were used for independent samples and Wilcoxon signed rank tests for paired samples to compare grade data. Statistical significance was determined by $P < 0.05$.

3. Results

3.1. Baseline data

Comparisons of baseline data from the two groups demonstrated that they did not differ significantly in sex, age, or educational attainment (Table 1).

3.2. Changes in oral cleaning behavior

Comparisons of the changes in oral cleaning behavior at the first visit and 3 months after implant

Table 1
Comparison of baseline data of patients in the two groups ($\bar{X} \pm$ SD; n, %)

Group	Sample size	Sex (male/female)	Mean age	Educational level (college degree or higher/High school or less)
Control group	35	21/14	51.03 ± 9.48	19/16
Experimental group	35	22/13	50.91 ± 9.87	18/17
χ^2/t		0.060	0.049	0.057
P		0.806	0.961	0.811

Table 2
Comparisons of the changes in oral cleaning behavior at different time between the two groups (n, %)

	Control group ($n = 35$)			Experimental group ($n = 35$)			
	First stage	Action	Maintenance	First stage	Action	Maintenance	
First visit	18	13	4	17	13	5	$Z = 0.311, P = 0.756$
Three months later	17	14	4	5	12	18	$Z = 3.892, P = 0.000$
	$Z = 1.000, P = 0.317$			$Z = 5.000, P = 0.000$			

restoration between the two groups revealed that at the first visit, no significant differences existed between the two groups in oral cleaning behavior ($P > 0.05$) Nevertheless, the experimental group demonstrated significantly better oral hygiene behavior after three months of implant restoration ($P < 0.05$). And a significant improvement in oral cleaning behavior was observed in the experimental group 3 months after implant restoration compared to that before intervention ($P < 0.05$), while there were no significant changes observed in the control group ($P > 0.05$) (Table 2).

3.3. Periodontal clinical indices

Comparisons of periodontal clinical indices between the two groups at first visit and 3 months after implant restoration demonstrated that, on the day of implant restoration, there were no significant differences in periodontal clinical indices (mPLI, mSBI, PIS, and PD) among the two groups ($P > 0.05$). After three months of implant restoration, significantly better results were observed in the experimental group than in the control group for mPLI and mSBI ($P < 0.05$); however neither PIS nor PD showed a significant difference ($P > 0.05$). Three months after implant restoration, the control group had significantly worse mPLI and mSBI than those on the day of implant restoration ($P < 0.05$), while neither PIS nor PD were significantly different at the two time points ($P > 0.05$). In the experimental group, PD and PIS on the day of implant restoration were not significantly different from those 3 months later ($P > 0.05$), while mPLI and mSBI 3 months after implant restoration were significantly better than those on the day of implant restoration ($P < 0.05$) (Table 3).

4. Discussion and conclusion

As an independent risk factor for peri-implantitis, chronic periodontitis influences the success rate of implant restoration [23]. Good oral cleaning habits can help patients with periodontitis who have undergone implant restoration effectively control dental plaque and prevent peri-implantitis and the recurrence of periodontitis [24]. However, traditional oral hygiene education has little effect on patient behavior development and change; patients usually give up adherence shortly after passively accepting oral or written advice. Therefore, how to enhance patient adherence and help them establish good oral cleaning habits is key to management of those with chronic periodontitis following implant restoration [25].

Table 3
Comparisons of periodontal clinical indices between the two groups at different time ($\bar{X} \pm S$)

Group	time	mPLI	mSBI	PIS	PD
Control group ($n = 35$)	On the day	1.54 ± 0.70	0.74 ± 0.56	1.49 ± 0.70	1.56 ± 0.60
	Three months later	2.06 ± 0.64	1.34 ± 0.80	1.54 ± 0.74	1.60 ± 0.70
t_a		4.620	5.454	1.435	1.358
P_a		0.000	0.00	0.160	0.183
Experimental group ($n = 35$)	On the day	1.77 ± 0.49	0.80 ± 0.53	1.57 ± 0.74	1.51 ± 0.59
	Three months later	1.11 ± 0.53	0.54 ± 0.51	1.66 ± 0.76	1.56 ± 0.58
t_a		6.083	3.431	1.785	1.785
P_a		0.000	0.002	0.083	0.083
t_b		1.582	0.438	0.498	0.321
P_b		0.119	0.663	0.620	0.749
t_c		6.720	4.991	0.635	0.297
P_c		0.000	0.000	0.528	0.768

Note: t_a and P_a are intra-group comparisons; t_b and P_b are inter-group comparisons on the day of implant restoration completed; t_c and P_c are inter-group comparisons 3 months after implant restoration.

Traditional oral hygiene education involves one-way dissemination of knowledge, which often fails to fundamentally address the issue of poor compliance of patients with periodontitis [26]. In this study, we applied MI based on the TTM to oral hygiene management of patients with periodontitis who have undergone implant restoration. Our experiments clearly demonstrate that behavioral interventions based on this approach can effectively raise oral health awareness in such patients and improve their compliance with oral cleaning behavior. Overall, we describe a new, low-cost method for oral health management of patients with chronic periodontitis undergoing implant restoration.

Before intervention, no significant differences were found in oral cleaning behavior between the two groups ($P > 0.05$), and most patients in both groups were in the first stage of behavior change (including precontemplation, contemplation, and preparation). After the intervention, the experimental group exhibited significantly improved oral cleaning behaviors in comparison to the control group, mainly reflected in the significant increase in the proportion of patients in the action and maintenance stages, demonstrating that MI based on the TTM can effectively enhance oral cleaning behavior changes toward a healthier direction. A possible reason for these results is that MI based on the TTM focuses the attention of medical staff on addressing patient motivation [27], and allows provision of more targeted intervention strategies, according to the different behavior stages of patients [28]. Thus, such an approach can better stimulate the subjective initiative of patients with periodontitis, encourage them to actively confront periodontitis, and enhance their self-confidence, thereby effectively improving patient oral cleaning behavior habits and enhancing their compliance, leading to a positive response. Furthermore, earlier interviews with patients indicated that the main reasons they did not take the initiative to carry out self-oral cleaning can be summarized as follows: (1) they were worried that oral cleaning behavior would have an adverse effect on the postoperative wound; (2) they were not aware of the important role of oral cleaning behavior in removing dental plaque and controlling periodontitis progression, or mistakenly thought that mouthwash could replace daily oral cleaning behavior; (3) they were unable to master the correct use of oral cleaning tools, such as toothbrushes, dental floss, and interdental brushes; and (4) older adults whose children had left home had little self-confidence in oral health management and lacked supervision. In view of the above findings, the interview group conducted health education, considering the particular situation of each patient, based on in-depth MI, including: (1) explaining to patients the adverse effects of poor oral cleaning behavior on the prognosis of dental implants; (2) encouraging family members to participate and urge patients to carry out self-oral cleaning; and (3) strengthening patient oral cleaning methods and regular follow-up. Therefore, compared with traditional oral hygiene education, the

intervention program based on TTM and MI used in this study represents targeted oral health guidance and behavior change education, according to in-depth analysis of the motivation and causes of patient behaviors, and it has a clear effect in promoting improved behaviors. The results of this study also suggest that, when treating periodontitis and other chronic diseases, healthcare professionals should focus on determining patient understanding of the effects of lifestyle and disease, as well as the internal causes and motivations for their behaviors, and prioritize the influence of patient psychological factors on behaviors.

In addition, we found that, 3 months after implant restoration, a better periodontal status was observed in the experimental group than in the control group, mainly manifested as significantly better mPLI and mSBI in the experimental group compared to the control group ($P < 0.05$). Further, in the experimental group, mPLI and mSBI 3 months after implant restoration were significantly better than those on the day of implant restoration ($P < 0.05$). However, in the both groups, there was no significant difference in PD and PIS at 3 months after implant restoration compared with the day of restoration($P > 0.05$). The possible reason is that the reconstruction of alveolar bone and gingival papilla takes a long period, but the observation time in this study is too short to observe significant clinical changes. The above findings indicate that MI based on the TTM can help patients with periodontitis to effectively control dental plaque, which is closely associated with the formation of oral cleaning habits. The change of patient oral cleaning behavior is of great significance in effective prevention of peri-implantitis and achieving stable restoration effects.

This study, however, was limited by the small sample size, the short follow-up period, and the shallow depth of the research. Further research will be conducted in the future, to further enrich the theoretical basis for oral clinical application of MI based on the TTM. First, we will expand the sample size and prolong the intervention duration. In addition, we will pay particular attention to comparison of the effects of MI based on the TTM on patients with periodontitis of different ages, education levels, and sexes.

Acknowledgments

Conflict of interest

None to report.

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