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Oral Health Instruction Improves glycaemic Control as Minimally Invasive Periodontal Therapy in Patients with Diabetes: A Systematic Review

Kanako Toda[1,3], Koji Mizutani[2] and Kayoko Shinada[3]*

[1]Department of Health Sciences, Saitama Prefectural University, Saitama, Japan
[2]Department of Periodontology, Tokyo Medical and Dental University, Tokyo, Japan
[3]Department of Preventive Oral Health Care Sciences, Tokyo Medical and Dental University, Tokyo, Japan

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***For Correspondence:**
Kayoko Shinada, Department of Preventive Oral Health Care Sciences, Tokyo Medical and Dental University, Tokyo, Japan
E-mail: shinada.ohp@tmd.ac.jp
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ABSTRACT

Oral Hygiene Instructions (OHI) enable proper plaque control by promoting patient self-care habits. OHI yields to reduce inflammation in periodontal tissues by eliminating periodontal pathogens. However, few studies have evaluated the effect of OHI on glycemic control in patients with diabetes. This systematic review aimed to examine the following clinical question (CQ): Does OHI improve glycemic control in periodontitis patients with type 2 diabetes? Consequently, 17 relevant interventional studies were included in this review. No randomized clinical trial was detected to compare the clinical benefits of OHI alone. Some interventional studies demonstrated that OHI alone had the potential to improve hemoglobin A1C (HbA1c) levels, although the outcomes showed variability. Combining professional supragingival plaque removal with OHI had reported inconsistent results in improving glycemic control among studies. Although further well-designed studies are required, the possibility of glycemic control *via* OHI in periodontitis patients with type 2 diabetes has been suggested.

INTRODUCTION

Diabetes Mellitus (DM) is a chronic hyperglycemia caused by defects in insulin secretion or action. The hyperglycemic state directly damages vascular endothelial cells [1]. Leading to complications related to

macrovascular and microvascular disease [2]. Contrarily, periodontal disease is caused by the accumulation of pathogenic plaque and leads to a chronic inflammatory response [3,4]. The challenge of pathogenic bacteria enhances the secretion of inflammatory cytokines in the periodontal tissue, which triggers systemic inflammation [5]. Secondary inflammation by upregulated cytokines can increase insulin resistance, resulting in impaired glycemic control [6]. In addition, inflammation in periodontal tissue decreases antioxidant ability and increases systemic oxidative stress by increasing malondialdehyde and nitric oxide levels in the periodontal tissue [7-9]. Poor glycemic control due to DM exacerbates the parameters of periodontal disease [10-12].

Conversely, for more advanced periodontitis, DM and diabetic complications are increasingly severe [13,14]. Patients with DM show higher systemic inflammatory markers than patients without DM [15,16]. Periodontal therapy is intended to remove pathogenic bacteria from the supragingival and subgingival plaques. Since the removal of pathogenic factors improves periodontitis and decreases systemic inflammatory markers Periodontal therapy can downregulate systemic inflammation in patients with DM [17-19]. Recently, a consensus has emerged based on various meta-analyses that non-surgical periodontal therapy contributes to improved glycemic control in patients with type 2 DM (T2DM) [20-22]. Non-surgical periodontal therapy commonly include Oral Hygiene Instructions (OHI) and Scaling and Root Planning (SRP). OHI is defined as a key factor in the treatment plan for patients with periodontal disease and as part of the maintenance program following cause-related therapy [23]. In a clinical setting, dental hygienists mainly provide instructions on brushing and interproximal cleaning for optimal plaque control by the patients themselves. OHI eliminates the pathogenesis of periodontal disease and reduces inflammation in the periodontal tissue.

The pathway through which periodontal therapy promotes glycemic control is elucidated by the elimination of inflammation in periodontal tissues; therefore, improved supragingival plaque control with OHI is also hypothesized to reduce systemic inflammation. It is clinically relevant to determine the contribution of OHI to glycemic control in patients with DM.

However, there is a lack of reviews focusing on the clinical relevance of OHI on glycemic control in patient with DM. This study aimed to conduct a systematic review to investigate the following Clinical Question (CQ): Does OHI improve glycemic control in patients with periodontitis and T2DM?

LITERATURE REVIEW

Methodology

A search strategy was applied according to the Preferred Reporting Items for the Systematic Reviews and Meta-Analysis (PRISMA) protocol [24,25].

Search strategy

An extensive literature search was performed using the PubMed database to summarize the currently available knowledge and answer the aforementioned clinical question, by isolating Randomized Controlled Trials (RCTs) or

clinical trials investigating the effects of OHI with periodontal treatment in patients with T2DM prior to October 16, 2022. The search terms related to OHI were set according to previous studies. The search terms used in PubMed were as follows:

(periodontal diseases[MeSH Terms] OR periodontal disease[Title/Abstract] OR periodontium [MeSH Terms] OR periodontics[MeSH Terms] OR periodontitis[Title/Abstract] OR periodontitis [MeSH Terms]) AND ("diabetes mellitus"[MeSH Terms] OR "diabetes insipidus"[MeSH Terms] OR "diabet*"[Title/Abstract] OR "dm 1"[Title/Abstract] OR "dm i"[Title/Abstract] OR "dm 2"[Title/Abstract] OR "dm ii"[Title/Abstract] OR "glycated hemoglobin a"[MeSH Terms] OR "a1c"[Title/Abstract] OR "hb a1c"[Title/Abstract] OR "hba1c"[Title/Abstract] OR "blood glucose"[MeSH Terms] OR "blood sugar"[Title/Abstract] OR (("glucose"[Title] OR "sugar"[Title]) AND ("level"[Title] OR "control"[Title])) OR "hyperglycemia"[MeSH Terms] OR "hypoglycemia"[MeSH Terms] OR "glycemi*"[Title/Abstract] OR "glycaemi*"[Title/Abstract] OR "hyperglyc*"[Title/Abstract] OR "hypoglyc*"[Title/Abstract]) AND ("Oral Hygiene"[MeSH Terms] OR "Oral Hygiene"[Title/Abstract] OR "Dental Hygiene"[Title/Abstract] OR "Toothbrushing"[MeSH Terms] OR "Toothbrushing"[Title/Abstract] OR "Dental Prophylaxis"[MeSH Terms] OR "Dental Prophylaxis "[Title/Abstract])).

Additional electronic searches were performed in the Journal of Periodontology, Journal of Clinical Periodontology, Journal of Periodontal Research, International Journal of Dental Hygiene, and their cited literature to increase the likelihood of identifying relevant papers [9,26].

Study selection

In the first stage, titles and abstracts of all retrieved articles were screened for potentially eligible studies. Full-length articles of the identified studies were examined in detail according to the eligibility criteria for inclusion in this review. Two reviewers (KT and KM) independently performed the screening process. In the case of a disagreement between the reviewers, a consensus was reached through discussion. The following studies were included:

1. RCTs examining the efficacy of OHI on Glycemic Control (HbA1c) in patients with both T2DM and periodontitis.

2. Studies with only OHI and/or periodontal treatment with supragingival prophylaxis and non-surgical therapy, such as SRP.

3. Studies with outcome variables including clinical parameters for periodontitis, such as probing Pocket Depth (PD) and Bleeding on Probing (BOP).

4. Studies published in English.

The exclusion criteria were as follows:

1. Review articles, case reports, descriptive studies, opinion articles, abstracts, animal experiments, and in vitro studies.

2. Clinical studies conducted on participants with diabetes other than T2DM, such as type 1 diabetes.

HbA1c was calculated based on National Glycohemoglobin Standardization Program (NGSP) (%) or International Federation of Clinical Chemistry (IFCC) (mmol/mol), and the conversion formula is as follows: IFCC (mmol/mol)=10.93 × NGSP (%)-23.52. The decimal places are rounded down. The NGSP was also used in this review to assess glycemic control.

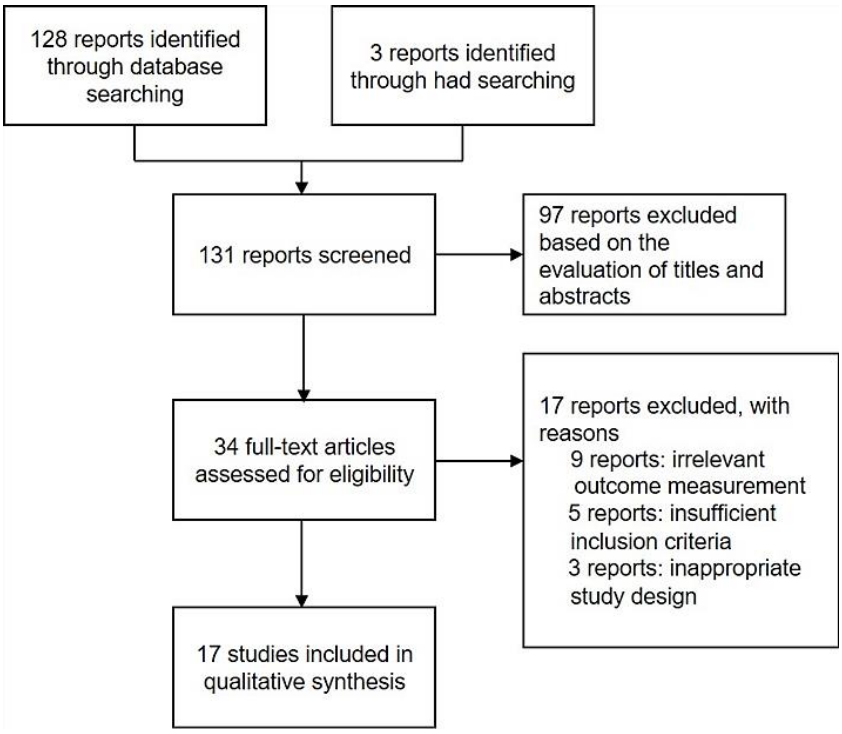
Assessment of risk bias

The risk of bias was evaluated in accordance with the Cochrane Handbook for Systematic Reviews of Interventions, using the following parameters: adequacy of sequence generation; allocation concealment; blinding of participants, personnel, and outcome assessors; incomplete outcome data; and selective outcome reporting [25].

Results

Search and selection results: After excluding duplicates from the results of the hand search, a total of 131 articles were identified; 128 reports were identified electronically while three were hand searches (Figure1). During the first stage, 97 reports were excluded based on the evaluation of titles and abstracts (inter-reviewer agreement, kappa statistic=0.88). Second, after screening the full texts of the remaining 34 articles, nine reports were excluded for irrelevant outcome measurement [27-35], Five reports had insufficient inclusion criteria [36-40], and three reports had inappropriate study design [41-43]. Finally, 17 investigations were included in this systematic review (inter-reviewer agreement, kappa statistic=0.91) (Figure 1) [44-60].

Figure 1. Study selection process



Assessment of methodological quality: The results of the methodological quality assessment are shown in Figures 2 and 3. As shown in Figure 1, all studies were assessed as having either a high risk of bias or an unclear risk of bias, although they were presented as RCTs. The randomization used in the included studies was a computer-generated random table, block design, closed envelopes [47-53,56,60]. However, some studies did not mention the randomization method [45,46,54,55,57-59]. The studies followed a blind method for operators [55], periodontal outcome assessors [45,46,50,52,53,55,57-60]. While, others had insufficient details regarding the blinding procedure [48,51,56,61]. Among all the seven domains of bias, "blinding of outcome assessment" as the detection bias, and "selective reporting" due to the lack of a sufficient description of the study plan and evaluated parameters, were the principal risk factors affecting the quality of the methodology (Figures 2 and 3).

Figure 2. Risk of bias summary: review author's judgments about each risk of bias item for each included study.

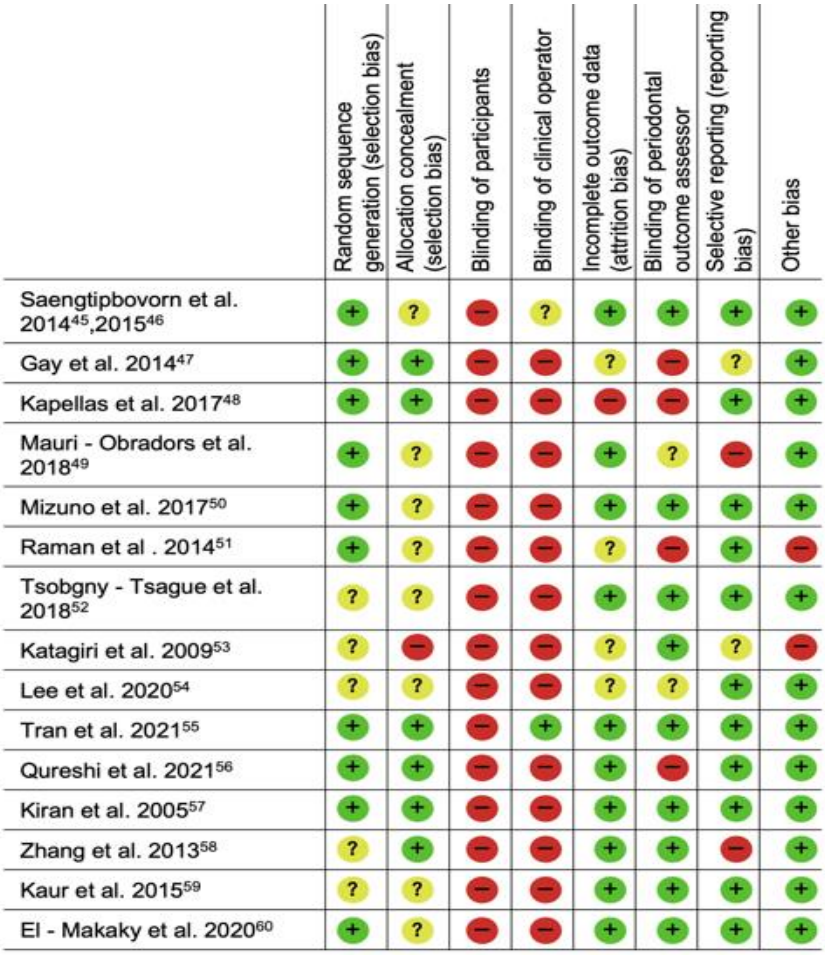
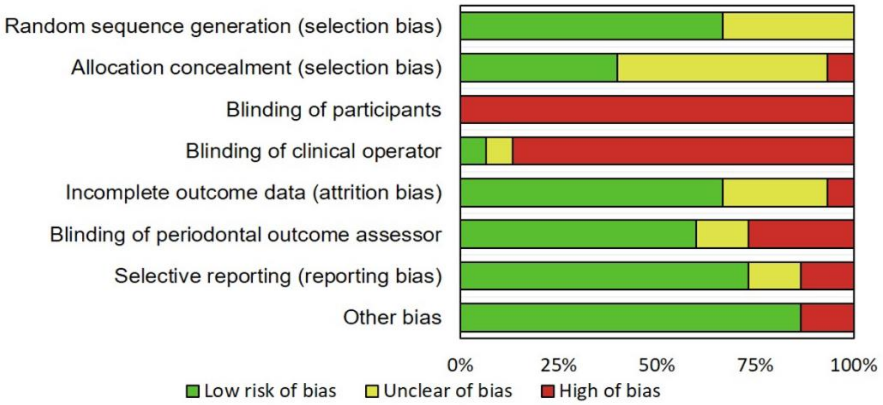


Figure 3. Risk of bias graph: Author's judgments about each risk-of-bias item presented as percentages across all included studies. Note: (■) Low risk of bias; (■) Unclear of bias; (■) High of bias.



Study characteristics and periodontal and diabetes parameters are shown in Table 1.

Table 1. Systemic reviews on the effect of oral hygiene instruct on periodontitis patients with type 2 diabetes mellitus. This is an original table prepared for this article.

	Study	Intervention	Evaluation term	Oral hygiene instruction	Glycaemic control after OHI		Main finding
					HbA1c at baseline	1-bA1c at final examination	
Pre-OHI vs Post-OHI	Toda et al. 2019 [44]	Treatment Group (n=20): OHI+Supragingival prophylaxis Control Group: None	1,3,6 month	Toothbrush, flossing and interdental brush	Treatment Group: 7.12 ± 0.74%	Treatment Group: 6.93 ± 0.64% n.s	OHI brushing and interdental brushing improved glycaemic control after 6 months, but not significantly; PCR significantly decreased at each evaluation.
OHI vs Non-intervention	Saengtip bovom 2014 [45] ,2015 [46]	Treatment Group (n=65): OHI+Life style change plus dental care program Control group (n=65): None	3,6 month	Tooth brushing with fluoride tooth paste floss, cleaning dentures how to self-check oral health	Treatment Group: 7.4 ± 1.2% Control Group: 7.7 ± 1.5%	Treatment Group: 7.1 ± 1.0% Control Group: 7.8 ± 1.5%	Glycaemic control was significantly improved in the OHI group with lifestyle intervention compared to that without OHI. The PI decreased significantly
	Gay et al.2014 [47]	Treatment Group (n=66): OHI+SRP Control group (n=60): OHI	4 month	Tooth brushing with modified bass technique, flossing and interdental brush	Treatment Group: 9.0 ± 2.3% Control Group: 8.4 ± 2.0%	Treatment Group: 8.4 ± 1.9%* Control Group: 8.1 ± 1.8%	OHI with brushing and proximal plaque control improved glycaemic control after 4 months, but the difference was not significant.
	Kapellas et al. 2017 [48]	Treatment Group (n=24): OHI+SRP Control group (n=20): OHI	3 month	Toothbrush and flossing provided a toothbrush and toothpaste at baseline	Treatment Group: 8.6 ± 4.4% Control Group: 7.7 ± 4.0%	Treatment Group: 8.2 ± 4.2% Control Group: 7.4 ± 3.9%	OHI with brushing and proximal plaque control improved glycaemic control after 3 months, but there was no significant change
	Mauri Obradors et al. 2018 [49]	Treatment Group (n=42): OHI+SRP Control group (n=48): OHI+ Supragingival prophylaxis	3,6 month	Tooth brushing at modified base technique	Treatment Group: N/A Control Group: N/A	Treatment Group: 7.2 ± 0.31% Control Group: 7.76 ± 0.37%	OHI with brushing instruction improved glycaemic control after 6 months, but the difference was not significant.

OHI with periodontal therapy vs Control without OHI	Mizuno et al. 2017 [50]	Treatment Group (n=20): OHI+SRP Control group (n=17): OHI	3,6 month	N/A	Treatment Group: 7.5 ± 1.7% Control Group: 7.7 ± 1.2%	Treatment Group: 7.4 ± 1.3% Control Group: 7.6 ± 1.1%	OHI improved glycaemic control at 6 months, but the difference was not significant. There was a slight improvement in plaque control.
	Raman et al 2014 [51]	Treatment Group (n=24): OHI+SRP and 0.12% chlorhexidine rinse Control group (n=20): OHI	1,2,3 month	OHI and motivation	Treatment Group: 7.8 ± 1.5% Control Group: 7.6 ± 1.5%	Treatment Group: 7.1 ± 1.2%* Control Group: 7.1 ± 1.2%	OHI improved glycaemic control at 3 months, but the improvement was not statistically significant; PI significantly improved.
	Tsobgny - Tsague 2018 [52]	Treatment Group (n=15): OHI+SRP and 0. 2% chlorhexidine mouth rinse Control group (n=15): OHI	3 month	Tooth brushing with modified base technique soft bristled toothbrush	Treatment Group: 9.7 ± 1.6% Control Group: 8.9 ± 0.9%	Treatment Group: 6.7 ± 2.0%* Control Group: 8.1 ± 2.6%	OHI brushing instruction improved glycaemic control at 3 months, but it was not significant; there was less plaque reduction in the control group then in the treatment group.
	Katagiri et al. 2009 [53]	Treatment Group (n=32): OHI+SRP+minocycline Control group (n=17): OHI	1,3,6 month	Tooth brushing, flossing and interdental brush	Treatment Group: 7.2 ± 0.9% Control Group: 6.9 ± 0.9%	Treatment Group: the reduced tended to continued there after Control Group: did not show any significant changes	OHI with brushing and proximal plaque control did not significantly change the glycaemic control at each evaluation.
	Lee et al.2020 [54]	Treatment Group 1(n=20): OHI+SRP Treatment Group 2(n=20): OHI+SRP+additional tooth brushing Control Group (n=20): OHI	3 month	Tooth brushing additional tooth brushing: Watanabe method	Treatment Group 1: 6.64 ± 0.29% Treatment Group 2: 6.68 ± 0.23% Control Group: 6.76 ± 0.39%	Treatment Group 1: 6.47 ± 0.34%* Treatment Group 2: 6.43 ± 0.35%* Control Group: 6.98 ± 0.51%*	OHI with brushing instruction significantly decreased glycaemic control after 3 months; OHI+SRP showed greater improvement in glycaemic control.
	Tran et al. 2021 [55]	Treatment Group (n=32): OHI+SRP Control group (n=32): OHI	3,6 month	Tooth brushing with bass technique floss once a day	Treatment Group: 7.34 ± 0.78% Control Group: 7.06 ± 0.72%	Treatment Group: 6.92 ± 0.63%* Control Group: 7.37 ± 0.75%*	OHI with brushing and proximal plaque control significantly decreased glycaemic control t 6 months, and PI was increased.
	Qureshi et al. 2021 [56]	Treatment Group 1(n=24): OHI+SRP+metronidazole Treatment Group 2(n=26): OHI+SRP Control Group (n=24): OHI	3,6 month	Tooth brushing with modified base technique soft toothbrush and fluoridated toothpaste	Treatment Group 1: 9.05 ± 1.70% Treatment Group 2: 9.05 ± 1.83% Control Group: 8.34 ± 1.26%	Treatment Group 1: 7.47 ± 1.19%* Treatment Group 2: 7.81 ± 1.43%* Control Group: 9.65 ± 1.85%*	OHI with fluoridated toothpaste application significantly impaired glycaemic control at 6 months.

OHI with periodontal therapy vs Control without OHI	Kiran et al. 2005 [57]	Treatment Group (n=22): OHI+SRP Control Group (n=22): None	3 month	N/A	Treatment Group: 7.31 ± 0.74% Control Group: 7.00 ± 0.72%	Treatment Group: 6.51 ± 0.80%* Control Group: 7.31 ± 2.08% n.s	Without OHI, glycaemic control was impaired at 3 months, and PI did not significantly decrease.
	Zhang et al. 2013 [58]	Treatment Group (n=49): OHI+SRP Control Group (n=22): None	3 month	N/A	Treatment Group: 7.68 ± 1.22% Control Group: 7.38 ± 1.30%	Treatment Group: 7.51 ± 1.31%* Control Group: N/A n.s	The control group that did not receive any periodontal treatment showed increased HbA1c levels, but this was not significant.
	Kaur et al. 2015 [59]	Treatment Group (n=50): OHI+SRP Control Group (n=50): None	3,6 month	N/A	Treatment Group: 8.17 ± 2.49% Control Group: 7.87 ± 2.56%	Treatment Group: 7.29 ± 1.61%* Control Group: 8.06 ± 2.72%*	Without OHI, glycaemic control was impaired at 6 months, and PI was increased. No OHI resulted in worse glycaemic control at 6 months, but this was not significant, the PI tended to increase.
	El-Makaky et al. 2020 [60]	Treatment Group (n=44): OHI+SRP+antibiotics Control Group (n=44): None	3 month	N/A	Treatment Group: 8.12 ± 0.74% Control Group: 8.21 ± 0.71%	Treatment Group: 7.27 ± 0.50% Control Group: 8.34 ± 0.64%	Not performing OHI resulted in poor glycaemic control at 3 months, but the difference was not significant, visible dental plaque was increased.

Note: *Comparison of baseline and final evaluation data ($p<0.05$).
Abbreviations: SRP: Scaling and Root Planning; OHI: Oral Hygiene Instruction; HbA1c: Glycated Haemoglobin; PI: Plaque Index; PCR: Plaque Control Record; N/A: Not applicable; n.s not significant.

Pre-OHI *vs* Post-OHI: Toda et al. conducted a cohort study of 20 Japanese patients with T2DM who were following OHI performed by a dental hygienist [44]. The OHI included individual brushings and proximal plaque control using dental floss or interdental brushes according to the patient's plaque control level. The results showed that the O'Leary plaque control record (PCR) significantly decreased from 48.2 ± 15.5% at baseline to 34.9 ± 13.5% after 3 months and to 31.5 ± 15.6% after 6 months [62]. The HbA1c level decreased from 7.12 ± 0.74% at baseline to 6.93 ± 0.64% at 6 months, although no significant differences were found.

OHI *vs* Non-intervention: Motivational interventions have been reported to benefit glycemic control. A study of T2DM patients aged >60 years found that the group that combined both lifestyle changes and dental care OHI had significantly lower HbA1c levels at 3 and 6 months examinations compared to the control group without OHI [45,46].

OHI *vs* OHI with periodontal therapy: Gay et al. demonstrated that HbA1c levels in the OHI group (n=60) decreased from 8.4 ± 2.0% at baseline to 8.1 ± 1.8% after 4 months [47]. The SRP group received with an ultrasonic scaler and Gracey curettes under local anesthesia along with OHI. Despite no statistically significant difference in reduction in the OHI group compared to the SRP group, the OHI group showed an improvement in glycemic control. In the study by Kapellas et al., HbA1c in the OHI group (n=20) decreased from 60.8 ± 20.3 mmol mol^{-1} (7.8 ± 4.1%) at baseline to 57.3 ± 18.6 mmol mol^{-1} (7.4 ± 3.9%) after 3 months, but was not statistically significant [48]. In study by Mauri-Obradors et al., all participants received OHI with tooth brushing instructions using the modified Bass technique. The SRP ewith OHI group showed a 0.51% reduction in HbA1c levels at 6 months (n=35), but the OHI alome group also showed a reduction of 0.06% (n=48) [49]. The SRP with OHI group had more smokers than the OHI group, which may have resulted in a poor response to SRP [63].

A study by Mizuno et al. showed that there was no change in HbA1c level from 7.7 ± 1.2% at baseline to 7.7 ± 1.1 after 6 months in the OHI group (n=17) [50]. This study had a small plaque reduction after OHI (PCR: 48.4 ± 19.6% to 42.6 ± 22.6), which might have resulted in no improvement in glycemic control. Conversely, a study by Raman et

al. showed a significant reduction in plaque control parameter from 31.70 ± 21.08 to 4.88 ± 5.88 [51]. The OHI conducted once a month decreased HbA1c level from 7.6 ± 1.5% at baseline to 7.1 ± 1.2% at 3 months (n=17). Frequent OHI may improve patients' plaque control skills because repeated instruction provides a beneficial opportunity for patients to improve their plaque control skills.

Following modified Bass technique and dental floss usage, significantly decreased the PCR from 79.3 ± 19.3% to 63.7 ± 15.5% [52]. HbA1c level at baseline improved from 8.9 ± 0.9% to 8.1 ± 2.6% after 3 months. In other study, the group following OHI included brushing and inter-proximal cleaning, did not improve in HbA1c levels [53].

Some studies have shown that OHI alone did not affected or worsened glycemic control [54-56]. Tran et al. reported that the bass technique and the use of flossing once a day, did not show significant effect on HbA1c levels for 6 months observation [55]. Some studies have reported statistically significant increases in HbA1c levels [56].

OHI with periodontal therapy *vs* Non-intervention OHI: In comparative studies, the group without OHI showed elevated blood glucose levels during the observation period. In a study conducted in 44 patients with T2DM, HbA1c levels decreased by 0.86 ± 0.06% in the treatment group with OHI and SRP, but increased by 0.31 ± 1.36% in the non-intervention group without OHI, for 3 months observation [57]. A study by Zhang et al. in which SRP was administered to the treatment group, showed a significant decrease in HbA1c of 0.13 ± 0.34% for 3 months observation. In the control group that did not receive any periodontal treatment, HbA1c increased by 0.03 ± 0.22% [58]. In another study, HbA1c decreased by 0.88 ± 1.00% in the SRP with OHI group, whereas it significantly increased by 0.18 ± 0.38% in the non-intervention group without OHI, for 6 months observation [59].

DISCUSSION

Seventeen intervention studies were included in this systematic review. OHI was provided to both the treatment and control groups in most studies. No randomized clinical trials have thus far been performed to compare the clinical benefits of OHI alone. Some interventional studies have shown the potential to improve HbA1c levels with OHI alone, although the outcomes showed variability. Combining professional supragingival plaque removal with OHI has demonstrated inconsistent results in improving glycemic control. Depending on the glycemic control status and severity of periodontitis, OHI and supragingival prophylaxis therapy would be sufficient to achieve a positive effect. Due to variations in research protocols, a meta-analysis of the included studies could not be performed. Further well-designed studies are required to evaluate the possibility of glycemic control *via* OHI.

Periodontitis is caused by an interaction between the host immune response and inflammation caused by pathogens in the biofilm [4]. Patient self-care removes supragingival plaque, which reduces chronic systemic inflammatory markers. Studies have suggested that well-plaque control tends to improve glycemic control [44,50-52]. Proximal hygiene tools demonstrated a certain benefit to improve glycemic control in studies, although it is consistent [44,45,52,53,55]. The patients' original habits and control skill were related to the continuation of proximal plaque control.

Several studies have examined the effect of specific OHI contents on glycemic control. Clinical studies are required to investigate the effects of various types of oral cleaning procedures such as toothbrushes, sonic toothbrushes, and proximal cleaning tools. The 0.12% chlorhexidine mouthwash and brushing groups showed a 0.8% reduction in HbA1c levels [64]. The effect of adjunctive mouth rinses requires further investigation regarding inflammation control. Dental floss or interdental brush use twice daily in addition to oral cleaning procedures has a higher potential to reduce periodontitis through plaque elimination than toothpaste alone [65]. In addition, ethical issues should be considered, and further data from studies without dental interventions as a control group are needed [22].

Hyperglycemia leads to macrovascular and microvascular-related complications and increases the mortlity of patients with DM. For example, a 0.2% decrease in HbA1c levels in patients with diabetes is associated with a 10% reduction in mortality over 2–5 years [66,67]. Some studies have indicated that OHI improves HbA1c levels in T2DM by 0.1–0.8% [50,52]. Which might suggests that OHI has the potential to improve health.

Patients with DM are more likely to recognize that periodontitis reduces their quality of life regardless of their glycemic control levels compared to healthy individuals [68,69]. Extended interventions during dental care should be generally avoided in patients with diabetic cardiovascular complications [70,71]. Criteria for the diagnosis of periodontitis in older subjects may require modifications of the definitions of periodontal diseases currently used in younger adults as older adults are often diagnosed with more than one chronic disease such as DM, and therefore use several medications [66]. Following the consensus report on dental caries and periodontal diseases in the aging population, dental care should be modified for retaining a pain-free, functional dentition, using minimally invasive and/or palliative treatment strategies while considering the medical aspects [67]. Minimaly invasive periodontal therapy may be the first choice for patients with DM [72]. OHI is recognized as one of the least interventional dental care. Appropriate plaque control plays a fundamental role in periodontal treatment, reducing periodontal inflammation and significantly upregulating the therapeutic outcomes of treatment. OHI can reduce the physical, psychological, and economic stress on patients during dental care by effectively providing periodontal therapy. The use of resources of dental professionals may also be potentially reduced by OHI. Because the OHI does not include operative procedures, it is possible to provide instructions to a group of patients.

CONCLUSION

This systematic review has several limitations. First, there have not been a sufficient number of studies suitable for the design to prove the impact of OHI. There have been many studies examining the effects of nonsurgical periodontal treatment. However, few have taken the perspective of OHI as the main focus of the intervention. To accumulate evidence regarding the effect of OHI in patients with type 2 diabetes, more well-designed RCTs with sufficient sample sizes based on the power calculation should be conducted with reference to Cochrane's risk-of-bias assessment criteria. Second, statistically significant improvements in glycemic control with OHI have been made only in limited reports. This should be interpreted carefully as a concluding statement of the literature review. This systematic review included 17 interventional studies on the effects of OHI on glycemic control in individuals with DM. Although further studies are required, the results indicate the potential for improving glycemic control *via* OHI in chronic periodontitis patients with T2DM.

CONFLICT OF INTEREST

The authors declare no conflict of interest

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