



Efficacy of glycine powder air-polishing combined with scaling and root planing in the treatment of periodontitis and halitosis: A randomised clinical study

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Abstract

Introduction: This study was performed to evaluate the clinical efficacy of using the Perio-Flow device (Electro Medical Systems, Nyon, Switzerland) adjunctively with mechanical instrumentation on periodontal parameters and halitosis.

Materials and Methods: Sixty patients who presented with a 4- to 6-mm probing pocket depth were recruited for the study. Patients were randomly assigned to scaling and root planing (SRP) or SRP + glycine powder air-polishing (GPAP). For both groups, the plaque index, gingival index, pocket depth, bleeding on probing, and clinical attachment level scores were recorded at baseline and 1 month. Volatile sulphur compounds (VSCs) were measured by a Halimeter (Interscan Corp., Chatsworth, CA, USA) at baseline, immediately after treatment, and at 7, 14, and 30 days.

Results: Both groups showed significantly lower plaque index, gingival index, pocket depth, bleeding on probing, and clinical attachment level gain scores at 1 month than at baseline. No significant differences were found between the groups at any time point. The VSCs were significantly different at 1 month compared with baseline in both groups. However, the intergroup comparisons of VSCs were not statistically significant at any time point.

Conclusion: Within the limits of this study, SRP is effective for treatment of periodontitis and halitosis. However, using GPAP adjunctively with mechanical instrumentation has no beneficial effects on halitosis or periodontal parameters.

Keywords

Ultrasonic scaler, subgingival plaque removal, air polishing, halitosis

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Introduction

Slightly more than a century ago, scaling and root planing (SRP) appeared to be necessary for the maintenance of periodontal health. SRP was the only treatment for periodontal disease. Despite recently developed techniques, SRP remains the most important part of periodontal disease treatment.¹ The classic devices used for root surface debridement are oscillating scalers and hand instruments.^{2,3} The beneficial effects of scalers and hand instruments combined with personal plaque control in patients undergoing SRP have been verified. These benefits include reduction of clinical inflammation, microbial shifts to a less pathogenic subgingival flora, a decreased probing depth (PD), and increased clinical attachment. However, as the pocket depth increases, the efficiency of plaque elimination may decrease.⁴ Dragoo⁵ and Clifford et al.⁶ assessed traditional and 'microultrasound' scaling tips with respect to their capacity to achieve the most apical extension of the periodontal pockets; however, they obtained contradictory results. Dragoo⁵ reported that only a few of the instruments reached the most apical depth of the pocket. In contrast, Clifford et al.⁶ reported that both types of scaling tips could reach and debride dental plaque in pockets with depths of 4 to 6 mm and 7 mm. The literature contains various reports supporting successful long-term maintenance following traditional air-polishing treatment.⁴

Dental plaque progresses from aerobic, gram-positive colonisation to anaerobic colonisation favouring gram-negative growth. As bacterial plaque develops, the oxygen level drops to zero, favouring decreased oxygen conditions and the production of odoriferous volatiles.⁷ Oxygen is consumed by bacteria that utilise oxygen to oxidise substrates (anaerobes) from saliva and gingival fluid. Studies have suggested that periodontitis increases the severity of halitosis.⁸

The bleeding tendency of the periodontal tissues may supply fundamental substrates for odour production. When periodontal tissues are inflamed, they provide more methionine, which is changed into methyl mercaptan at a higher rate than in healthy gingival tissues. The increased gingival crevicular fluid flow in the presence of periodontitis may be a constant source of methionine. Increased salivary putrefaction may occur due to a higher concentration of disintegrated epithelial cells.⁹ A few reviews have suggested that the production of volatile sulphur compounds (VSCs) by these gram-negative bacteria may contribute to the improvement of periodontal disease via breakdown of the oral mucosa, prompting bacterial invasion.¹⁰

Air polishing using a conventional air-polishing device with fine-grain (DV90: 63 µm) glycine powder aimed directly into the periodontal pocket has been demonstrated to be efficacious and safe for removing the subgingival biofilm in periodontal pockets. In one study, glycine powder air-polishing (GPAP) reduced the total viable bacterial counts in periodontal pockets with PDs ranging from 3 to 5 mm and to a significantly greater extent than SRP using curettes.¹¹ However, no studies have investigated the efficacy of using GPAP adjunctively with SRP in the treatment of halitosis. Therefore, the aim of this clinical study was to evaluate the effect of using GPAP adjunctively with SRP on periodontal parameters and halitosis.

Materials and methods

In the present trial, 60 patients (age range, 28–68 years) who had at least three teeth with 4- to 6-mm periodontal pockets were recruited from patients undergoing periodontal treatment at the Department of Periodontology of our institution. The exclusion criteria were acute infectious oral

lesions, furcation defects, use of antibiotics for any reason within the last 4 weeks, periodontal treatment within the last 6 months, and pregnancy or lactation.

Patient standardisation

All patients were instructed to avoid spicy food containing ingredients such as garlic, onions, and peppers as well as alcoholic drinks and mouthwashes for 2 days prior to halimetry. On the day of the examination, the patients were instructed to avoid coffee, candy, chewing gum, breath mints, perfumes, deodorants, shampoos, creams, and scented moisturisers. They were also advised to have breakfast at least 2 h and no more than 4 h before the examination.

Periodontal examination

The plaque index (PI),¹² gingival index (GI),¹³ clinical attachment level (CAL), PD, position of the gingival margin, and bleeding on probing (BOP) were measured at baseline and 1 month after treatment by a single calibrated examiner who was not aware of the type of treatment applied. The PI, GI, PD, position of the gingival margin, and BOP were evaluated with a periodontal probe at six sites on all teeth. BOP was assessed by the percentage of sites that bled after probing.

Evaluation of VSCs

A portable sulphide monitor (Halimeter, #RH17K; Interscan Corp., Chatsworth, CA, USA) was used to assess the VSC levels. Measurements using the Halimeter were taken according to the manufacturer's instructions. Three Halimeter readings were taken, and the calculated average was recorded as ppd. Halimeter measurements were performed at baseline, immediately after treatment, and on days 7, 14, and 30.

Study design

This was a computer-randomised, single-blind, controlled clinical study. After being given verbal information about the treatment plan and potential discomforts and risks, the patients who provided written informed consent were included in the study. The study protocol and related consent forms were approved by the Ethics Committee of Near East University (# NEU/2015/33-236). All patients had previously undergone and completed initial periodontal therapy. The patients were divided into two groups. In the control group, SRP was performed using an ultrasonic scaler (Piezon Master 700; Electro Medical Systems, Nyon, Switzerland) and hand instrumentation. In the test group, in addition to SRP with ultrasonic and hand instrumentation, GPAP (Air-Flow Perio Powder; Electro Medical Systems) was performed for 10 seconds per periodontal pocket using a Perio-Flow device (Air-Flow Master; Electro Medical Systems).

Statistical analysis

The mean values of the clinical parameters were calculated for all groups. One-way repeated analysis of variance was used to evaluate the changes in VSC values over time within the groups. *Post hoc* comparisons were performed using Tukey's test when significance was detected. A *t*-test was used for comparison among groups at each time point. Changes in periodontal parameters after treatment were assessed by paired *t*-tests in dependent groups. Values of $P < 0.05$ were considered statistically significant.

Results

All 60 patients completed the 1-month study period. The changes in the PI, GI, PD, BOP,

and CAL in the control and test groups are presented in Table 1. In both groups, the PI, GI, PD, BOP, and CAL gain scores were significantly lower at 1 month than at baseline. However, there were no significant differences in the PI, GI, PD, BOP, or CAL at the intragroup comparisons. The changes in the VSC values in both groups are presented in Table 2. The VSC values were significantly different between baseline and 1 month in both groups. However, the intergroup comparisons of the VSC

values showed no significant differences at any time point.

Discussion

Dental plaque in the periodontal pocket and on the root surface was recently shown to cause changes in biological structure. Bacterial exotoxins that penetrate the root surface, antibody complexes, and microbial metabolism lead to these changes.¹⁴ The efficacy of periodontal therapy is directly related to the percentage of bacteria in the pocket.¹⁵ Mechanical debridement constitutes the initial and arguably most critical method of managing inflammatory periodontal disease. Based on measurable endpoints, mechanical debridement is generally recognised for its effectiveness. These endpoints include CAL, PD, BOP, and alterations in the subgingival microflora.⁴ Effective root surface debridement is difficult to perform because of anatomic limitations.¹⁶ Therefore, the use of GPAP may simplify periodic subgingival instrumentation and may be an alternative to the conventional techniques of subgingival biofilm removal.¹¹

The present study revealed that mechanical instrumentation and GPAP had the same effect on PI scores when used in periodontal pockets with moderate PDs. Similarly, Flemmig et al.¹⁷ showed that hand instrumentation and GPAP had the same effect on PI when used in periodontal pockets with PDs of up to approximately 3 to 5 mm.

Table 1. Changes in parameters between the two study groups from baseline to 30 days.

	Baseline	30 Days
Plaque index		
Control group	1.6362 ± 0.74	0.8550 ± 0.54*
Test group	1.2878 ± 0.68	0.6468 ± 0.47*
Gingival index		
Control group	1.8149 ± 0.72	0.6245 ± 0.55*
Test group	1.8054 ± 0.79	0.7694 ± 0.71*
Pocket depth (mm)		
Control group	4.7164 ± 0.57	3.4116 ± 0.67*
Test group	4.8936 ± 0.68	3.7789 ± 0.93*
Bleeding on probing		
Control group	0.8830 ± 0.26	0.1327 ± 0.28*
Test group	0.7871 ± 0.40	0.1296 ± 0.32*
Clinical attachment level (mm)		
Control group	2.2671 ± 1.48	1.2157 ± 1.41*
Test group	2.0627 ± 1.09	1.1965 ± 1.03*

Data are presented as mean ± standard deviation.

*Differences between baseline and 30 days after treatment were statistically significant in the intergroup comparisons for both groups; $P < 0.05$

No significant difference was present in any parameter in the intragroup comparisons.

Table 2. Halimeter volatile sulphur compound values.

	Baseline	Immediately after treatment	Day 7	Day 14	Day 30
Control group	93.93 ± 44.69 ^a	72.80 ± 31.38 ^b	77.83 ± 31.41 ^b	67.67 ± 18.36 ^b	72.00 ± 31.16 ^b
Test group	88.70 ± 37.13 ^e	85.63 ± 35.29 ^e	79.43 ± 31.38 ^e	68.87 ± 19.99 ^f	68.13 ± 23.92 ^f

Different superscript letters indicate statistical significance in the intragroup comparisons ($P < 0.05$) by Tukey's *t*-test. The intergroup comparisons of volatile sulphur compounds showed no significant differences at any time point.

Because the use of low-abrasive powder led to a significantly higher reduction in subgingival bacteria than hand instrumentation, it may be speculated that the clinical outcomes of periodontal maintenance therapy using subgingival air polishing may be equivalent to or even better than the clinical outcomes of conventional modes of debridement.¹⁸ In our study, the PD and BOP scores decreased in both groups, but the difference between the groups was not statistically significant. Similarly, Müller et al.¹⁹ also found a significant decrease in the PD and BOP in their ultrasonic and Perio-Flow groups when used with SRP at 3-month intervals, but no significant difference was found between the two groups. GPAP has been shown to be more efficient in debriding deep periodontal sites than SRP using curettes. The mean time needed to treat one deep periodontal site was 0.5 minutes for GPAP alone compared with 1.4 minutes for SRP.²⁰ Our results suggest that some of the classic methods are already sufficient because the pocket depths in the study were moderately deep.

Some researchers have found that intraoral bacteria metabolise desquamated epithelial cells and blood cells, leading to the production of VSCs from cysteine and methionine and thus increasing the VSC scores parallel to an increase in the gingival bleeding scores.²¹⁻²³ Many studies have also shown that periodontal diseases cause an increase in VSC values, which then decrease after periodontal treatment.²⁴ In the present study, the decrease in halitosis values was statistically significant at the end of treatment in both groups.

Tonzetich²⁵ reported that VSC production is associated with the periodontal pocket depth and the presence of deep periodontal pockets. A periodontal pocket is an ideal environment for VSC formation with respect to current bacterial profiles and sulphur sources.⁷ The amount of VSCs in the mouth increases in proportion

to the depth of the periodontal pockets. Koshimune et al.²⁶ found a statistically significant relationship between VSC values and the presence of periodontal pocket depths of >4mm and BOP. In another study, hydrogen sulphide production in periodontal pockets was semi-quantitatively measured and found to have a positive correlation between the periodontal pocket depth and the amount of hydrogen sulphide.²⁷ In the present study, both treatment modalities resulted in a significant reduction in VSC values, and the PD was found to be significant. Another study by Morita and Wang⁷ revealed a statistically significant difference between halitosis and BOP. Söder et al.²⁸ reported a positive correlation among halitosis, poor oral hygiene, periodontal disease, and BOP. No study has investigated the efficacy of GPAP in halitosis treatment; thus, we could not conduct a comparison. Additionally, the use of GPAP for deep periodontal pockets may be more effective in the treatment of halitosis, but further information is needed.

Conclusion

Our results suggest that there is a positive correlation between halitosis and periodontal disease. Within the limits of the present study, SRP is effective in the treatment of periodontitis and halitosis; however, using GPAP adjunctively with mechanical instrumentation has no beneficial effects on halitosis and periodontal parameters.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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