Subgingival Plaque Removal at Interdental Sites Using a Low Abrasive Air Polishing Powder

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Background: The aim of the study was to test the efficacy of a novel low abrasive air polishing powder in subgingival plaque removal at interdental sites during periodontal maintenance therapy (PMT).

Methods: Using a split mouth design, subgingival plaque was removed in 23 PMT patients using a low abrasive powder using a standard air polishing unit (test) or curets (positive control). Before and immediately after treatment, subgingival plaque samples were taken from interdental sites with 3 to 5 mm probing depth (PO) at 2 test teeth and 2 positive control teeth. To evaluate the influence of sampling on the microflora, plaque samples were also taken twice at 2 teeth without therapy with PD of 3 to 5 mm (negative control). PMT treatment and plaque sampling were repeated 3 times at quarterly intervals. Anaerobe cultivation was utilized to assess the mean reduction of total colony forming units (CFU) immediately after treatment.

Results: Test treatment resulted in a significantly greater reduction in subgingival bacterial counts (log 1.9 ± 0.7) than positive control treatment (log 1.1 ± 0.6) and subgingival plaque sampling alone (log 0.5 ± 0.5; P<0.05). Differences between positive and negative control were not significant (P<0.05).

Conclusion: The novel low abrasive air polishing powder is superior to curets in removing subgingival plaque at interdental sites with up to 5 mm probing depth in PMT. J Periodontol 2003;74:307-311.

KEY WORDS

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assess the efficacy of the low abrasive powder in the removal of subgingival plaque at interdental sites.

**MATERIALS AND METHODS**

The study was designed in accordance with the guidelines outlined in the Clinical Investigation Plans of Medical Devices for Human Subjects by the European Committee for Standardisation. Treatment, microbial, sampling and clinical examination were performed in triplicate at 3 successive PMT at 3-month intervals.

**Study Population**

Twenty-four patients treated for generalized moderate to severe chronic periodontitis at the Department of Periodontology, University of Münster, were enrolled in the study and gave their informed consent on a form approved by the Ethics Committee of the University of Münster.

**Inclusion Criteria.** Patients had a minimum of 20 teeth, be 18 to 65 years old, and be in good general health. Furthermore, they had to have at least 1 tooth, at least one per quadrant, with interdental sites with a probing depth of 3 to 5 mm without furcation involvement or subgingival restorations.

**Exclusion Criteria.** Patients presenting with one or more of the following diseases or conditions were excluded: contagious diseases; pregnancy or lactation; systemic diseases such as neutropenia, angranulocytosis, diabetes, or bleeding disorders. Patients were also excluded if radiotherapy or chemotherapy were performed before or during the study period; if antibiotic coverage was needed prior to dental treatment (i.e., to prevent endocarditis); or if any form of subgingival instrumentation had been performed or antibiotics used within the 3 months preceding the study.

**Randomization Procedure and Treatment**

Recruitment of the patients and periodontal examination with measurement of 6 sites per tooth using manual periodontal probes was done 3 months prior to study baseline by a periodontist. Treatment assignment was performed using a randomization list as follows: Two quadrants in each patient were assigned to test treatment (subgingival air polishing using the low abrasive powder) and 2 to positive control treatment (hand instrumentation). In each test and control quadrant, one tooth with an interdental probing depth of 3 to 5 mm was selected for microbial sampling before and immediately after therapy (2 test and 2 positive control teeth each). To assess the influence of plaque sampling on the subgingival microflora, one additional tooth not undergoing therapy within each half of the patient’s mouth was selected and samples were taken twice (2 negative control teeth). Thus, a total of six investigational teeth was selected (Fig. 1).

Test treatment with the low abrasive powder was performed with a standard air polishing unit. Before the start of treatment, the APD was set up according to the manufacturer’s instructions and its powder chamber was filled with the low abrasive powder to the indicated maximum level to ensure reproducible treatment conditions. Using the APD at medium water and powder setting, the jet was aimed parallel to the long axis of the root into the periodontal pocket for 5 seconds per surface to remove all subgingival plaque.

Sterile Gracey curets 5/6, 7/8, 11/12, and 13/14 were used for positive control treatment. Instrumentation was terminated when no plaque was visible on the instrument blade after removal of the curet from the pocket. Hand instrumentation as well as subgingival air polishing were performed by the same periodontist.

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Stoma, Tuttingen, Germany.

EMS Air Flow S1, EMS, Pyon, Switzerland.
Microbial Sampling and Analysis
Plaque samples were taken by inserting one sterile paper point at the interdental area to the bottom of the pocket for 10 seconds after isolating the area with sterile gauze. Any supragingival plaque present on test or control teeth was carefully removed using sterile scalers and curets before taking the first sample. The paper points were transferred immediately to 500 µl sterile 0.25% Ringer’s solution and brought to the laboratory within 5 minutes, then sonicated# for 10 seconds and diluted in 10-fold steps. Ten µl of the dilutions were dispersed on a CDC blood agar plate and incubated for 7 days using anaerobe conditions (37°C, 5% CO2, 5% H2, 90% N2). The total number of colony forming units (CFU) was assessed for each sample by a blinded investigator using a stereomicroscope, and depicted as log CFU.

Statistical Analysis
The patient was used as the statistical unit and CFU values assessed within each patient at both treatment sessions before and after therapy respectively were averaged. A Wilcoxon test was performed to test for intergroup differences in mean CFU values before therapy. For efficacy assessment of the applied treatment regimens, Friedman statistics were used ($P < 0.05$). All statistical tests were performed with a statistical software package.**

Criteria for Study Termination
Untimely study termination was designated in the event of severe health hazards for the study patients according to the clinical investigation plans of the European Committee for Standardisation.26,27

RESULTS
Test and Control Teeth
Twenty-four patients were enrolled in the study (mean age 47.3 ± 11.6 years, 10 females, 14 males); 1 male patient was excluded since he moved away and could not be reached for assignment of further appointments. Thus, the reported results are based on 23 patients overall with a mean time interval of 3.3 ± 0.3 months between the PMT sessions. Information on the investigational teeth is found in Table 1.

Reduction in Microflora
Subgingival plaque removal using the low abrasive air polishing powder resulted in a significantly higher reduction in mean CFU (log 1.9 ± 0.7) than positive control treatment (log 1.1 ± 0.6). Curet instrumentation also reduced mean subgingival CFU; however, the difference from the influence of sampling alone (log 0.5 ± 0.5; $P <0.05$) was not significant (Fig. 2). Pretreatment subgingival microbial counts did not differ significantly between groups (log CFU pretreatment: test 5.2 ± 0.75; positive control 5.1 ± 0.76; negative control 4.9 ± 0.85).

Clinical Observations
There was no difference immediately after instrumentation in the clinical appearance of the periodontal tissues following subgingival air polishing using the low abrasive powder compared to control instrumentation with curets. Nor were there any major adverse effects during the study period. However, a few hours after instrumentation one male patient reported slight but painless bleeding at the mesiobuccal aspect (PD: 3 mm) of an upper right canine which had been treated with the low abrasive powder. Following thorough clinical examination, the bleeding was stopped with 3-minute bidigital compression of the involved site with sterile gauze. When the patient presented for the next treatment, there were no pathological findings and a probing depth at 3 mm was measured. One female patient once reported a transient prickling yet painless sensation on the skin of her cheeks due to powder residues following treatment. Apart from that, no further side effects or adverse reactions were reported by the patients or ascertained by the operator for either subgingival air polishing or hand instrumentation during the triplicate PMT in 23 patients.

DISCUSSION
The pronounced reduction in mean CFU following the use of the low abrasive air polishing powder may be attributed to the fact that the jet of air, water, and powder flushes away bacterial plaque due to the combi-

Table 1.
Allocation to Tooth Groups and Frequency Distribution of Probing Depths of Test, Positive Control, and Negative Control Teeth

<table>
<thead>
<tr>
<th>N Teeth</th>
<th>Test</th>
<th>Positive Control</th>
<th>Negative Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxilla</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incisors</td>
<td>9</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Premolars</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Molars</td>
<td>11</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Mandible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incisors</td>
<td>6</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Premolars</td>
<td>6</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Molars</td>
<td>11</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

Probing depth distribution

<table>
<thead>
<tr>
<th>Probing depth distribution</th>
<th>Test</th>
<th>Positive Control</th>
<th>Negative Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 mm</td>
<td>27</td>
<td>24</td>
<td>29</td>
</tr>
<tr>
<td>4 mm</td>
<td>15</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>5 mm</td>
<td>3</td>
<td>5</td>
<td>5</td>
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</table>
nation of the powders low abrasive properties and the effects of pressurized water acting as an irrigating agent. Previous in vitro studies have demonstrated, that using the APD with water but without powder does not result in plaque removal on freshly extracted teeth.\textsuperscript{25} Also, clinical studies have shown that the reduction of subgingival microbiota after subgingival irrigation is negligible.\textsuperscript{30,31} Therefore, the bacterial reduction following the new treatment regimen must be attributed to the effects of the low abrasive powder. The less pronounced mean reduction in CFU for hand instruments may be due to the shape and size of the hand instruments leading to reduced accessibility to the interdental subgingival space apical of the cemento-enamel junction.\textsuperscript{32,33}

Using the low abrasive powder for subgingival plaque debridement in periodontal patients may offer a time-saving mode of instrumentation in PMT, since instrumentation over 5 seconds was sufficient to remove subgingival plaque. Thus, less than 15 minutes may be needed to deplaque a complete dentition. However, if calculus or heavy staining is present, it must still be removed with more aggressive periodontal instruments such as oscillating scalers or hand instruments due to the low abrasiveness of the powder. Previous studies have demonstrated, that a total of more than 60 minutes may be needed to complete PMT using conventional instruments.\textsuperscript{6} Thus, the combination of supra- and subgingival deplaking using the low abrasive powder with calculus removal using hand- or machine-driven instruments promises to be time saving compared to using hand instruments or power driven scalers alone.

Since using the low abrasive powder led to a significantly higher reduction in subgingival bacteria than hand instrumentation, it may be speculated that the clinical outcomes of PMT using subgingival air polishing may be as good as or even better than conventional modes of debridement. However, since sites deeper than 5 mm were not assessed, long-term clinical studies are needed to substantiate these promising results before air polishing with the low abrasive powder can be recommended as the sole mode of plaque removal during PMT.

Potentially negative side effects of air polishing devices operating with conventional sodium carbonate powders, such as high abrasion of root cementum and dentin, unpleasant perception by the patient, mild to severe epithelial abrasion at the gingiva, and even air emphysema have been reported previously.\textsuperscript{21,34-40} The use of the low abrasive powder however, which has so far been evaluated during 3 PMT treatments in the assessed 23 patients, can be considered safe. As reported in the results, no major gingival damage occurred during the 3 sessions. In conclusion, the novel low abrasive air polishing powder achieved a significantly higher reduction in mean CFU in up to 5 mm deep interdental sites in patients receiving PMT.

**ACKNOWLEDGMENTS**

The authors are indebted to Ms. B. Walters for her kind assistance in performing the microbiological analysis. Ingo Häberlein is a member of the Research and Development Department of 3M ESPE and Thomas F. Flemmig is co-inventor of a patent on Clinpro Prophy-powder which is held by 3M ESPE.

**REFERENCES**


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Accepted for publication July 19, 2002.