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“Effectiveness and safety of a new dental plaque removal device
utilizing micro mist spray for removing oral biofilm in vitro”

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Summary

Hiroki Hihara, Ryo Tagaino, Jumpei Washio et al. Performed research on the topic of “Effectiveness and safety of a new dental plaque removal device utilizing micro mist spray for removing oral biofilm in vitro”. The original research was published in BMC Oral Health Journal in June 2021 and was conducted by Tohoku University Graduate School of Dentistry, Japan (<https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-021-01647-4>).

The new oral plaque removal device, Micro Scale Mist UNIT (MSM-UNIT), has been developed due to the lack of devices that are safe and effective in biofilm removal in the entire oral cavity. The MSM-UNIT was compared to AIRFLOW Prophylaxis Master on the removal of artificial biofilm with *Streptococcus mutans* on the simulated tooth surface and mucous membrane. The effectiveness and safety of both devices were evaluated by electron microscope and microscope camera.

The research concluded that MSM-UNIT spray is effective in oral biofilm removal and is safe to use on the simulated tooth surface and mucous membranes when compared to AIRFLOW and recommended the clinical studies to be as next step to confirm the conclusion.

Article information

The title of the article is “Effectiveness and safety of a new dental plaque removal device utilizing micro mist spray for removing oral biofilm in vitro”. Authors of the article are Hiroki Hihara, Ryo Tagaino, Jumpei Washio et al.. The article was published at BMC Oral Health (<https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-021-01647-4>), on June 4, 2021. Article’s DOI is <https://doi.org/10.1186/s12903-021-01647-4> . The author stated there are no conflict of interest.

Study Analysis

This original research has an experimental design where the new experimental plaque biofilm device, MSM-UNIT is evaluated for effectiveness and safety, while also being compared to AIRFLOW, as a control, a biofilm removal device with similar characteristics. It was

originally conducted in Japan's Tohoku University Graduate School of Dentistry, in the Division of Advanced Prosthetic Dentistry, in June 2021.

The experimental research was originally designed to determine the safety and effectiveness of biofilm removal by MSM-UNIT from the simulated tooth surface and entire oral mucosa. There are methods and tools for plaque removal, but those devices are not approved to cover the entire oral mucosa. Good biofilm control affects not only caries and periodontal disease development, but also the incidence of gastrointestinal and respiratory infections in the elderly. The newly developed device would make plaque control easier for the elderly who require long-term nursing care. Better plaque control would improve the quality of life. The previous airflow devices were not safe to use on the entire oral mucosa since they caused pain and trauma. But the new MSM-UNIT sprays fine water droplets at lower power, sufficient for biofilm removal and not to cause pain or trauma.

The following study was conducted in vitro. Glass slides were used to simulate the tooth surface, and plastic slides with bonded Toughsilon and Sofreliner were used to simulate soft and hard parts of the oral mucosa. Also, saliva was collected from healthy individuals and turned into artificial biofilm on these slides for device testing. MSM-UNIT was used as the experimental device, and AIRFLOW Prophylaxis Master was picked as a control device when it was tested for effectiveness. When it was tested for safety, the samples were not covered by biofilm. The control group in the safety test was an area not affected by either of the biofilm removal devices. To test the effectiveness of plaque removal, the researchers evaluated the biofilm adhesion areas and biofilm removal rates. This data was collected by analysis software utilizing the images from the microscope cameras prior to and after using the testing devices. The t-test was used to compare the outcomes. The safety factor was determined by utilizing non-biofilm samples and using the scanning electron microscope analysis software to determine surface roughness in three separate locations. To achieve statistically significant results, Dunnett's test was used to compare the results.

The results of effectiveness for biofilm removal on a slide glass by MSM-UNIT was $60.0 \pm 12.8\%$ and by AIRFLOW $32.5 \pm 9.9\%$. The removal of biofilm on Toughsilon by MSM-UNIT was $71.2 \pm 3.4\%$ and by AIRFLOW $48.5 \pm 8.3\%$. The removal of biofilm on Sofreliner by MSM-UNIT was $68.3 \pm 6.6\%$ and by AIRFLOW $51.8 \pm 8.5\%$. Removal rates for Sofreliner were

not statistically significant. Removal rates for glass slide and Toughsilon were statistically significant ($p < 0.05$), whereas MSM-UNIT showed a higher removal rate than AIRFLOW.

The results of safety for AIRFLOW and MSM-UNIT showed more damaged areas by AIRFLOW for both Toughsilon and Sofreliner. Surface roughness for the control group was recorded as $65.5 \pm 0.9 \mu\text{m}$ for Toughsilon and $58.7 \pm 0.7 \mu\text{m}$ for Sofreliner. Surface roughness for the AIRFLOW was recorded as $90.2 \pm 23.5 \mu\text{m}$ for Toughsilon and $66.2 \pm 7.3 \mu\text{m}$ for Sofreliner. Surface roughness for the MSM-UNIT was recorded as $66.2 \pm 0.9 \mu\text{m}$ for Toughsilon and $57.0 \pm 8.1 \mu\text{m}$ for Sofreliner. Surface roughness was greater on Toughsilon when treated with AIRFLOW. Surface roughness reminded similar on Sofreliner when treated with both device

The authors concluded that the new MSM-UNIT device proved to be effective and safe for biofilm removal. It is more effective mainly because MSM-UNIT spreads plaque circumferentially, where AIRFLOW pushes it in a single direction since MSM-UNIT is applied perpendicular to that issue and the AIRFLOW at 45 degrees to the tissue surface. Even though the lower power is generated by mist spray, biofilm was removed, since it generates about 10.5 kPa of shear stress when only 2 Pa is required. When AIRFLOW was compared to MSM-UNIT in terms of safety, AIRFLOW caused more cracks on samples, and MSM-UNIT results were similar to the control group, where minimal damage was done. Maintenance of good oral hygiene is one of the keys to reducing infections period since MSM-UNIT only utilizes water, there are no risks for allergy reactions. The only carried risk is an aspiration, but still, when compared to other devices, the water flow rate is much lower, requiring only a regular section device. Many devices provide biofilm removal for teeth surfaces but are not safe on the or there are no data on how they would affect the oral mucosa. The next step proposed by the authors is to take it to clinical trials since they will have more accuracy. It is impossible to fully simulate the life oral cavity of the human since there are a lot of factors that can influence results. However, MSM-UNIT has proven to be effective in plaque removal and safe in terms of damage to the oral mucosa when tested in vitro.

Such research is important to the field of dental hygiene because it introduces a new tool for prevention. One of the main goals of dental hygiene is the prevention of disease, and the new MSM-UNIT seems like a great tool for oral care. Even though it's in its earliest stage of development, I'm looking forward to seeing what improvements and qualities it would gain once

it becomes approved for use. But it's also great to see how important it might become for the elderly since it looks like a great tool for the prevention of gastrointestinal and respiratory infections. Since this article was done only as in vitro study, I'm wondering if this device will be strictly professional or available to be purchased in a pharmacy or store, because the public might have a high demand for such product. It might revolutionize the field of in-office treatment and home care for everyone.

Work Cited

Hihara, H., Tagaino, R., Washio, J. *et al.* Effectiveness and safety of a new dental plaque removal device utilizing micro mist spray for removing oral biofilm in vitro. *BMC Oral Health* **21**, 286 (2021). <https://doi.org/10.1186/s12903-021-01647-4>