DENTAL ADVISOR
Product insights you can trust.

Microbiology Research Report

Sabiha S. Bunek, D.D.S. and Delaney Graham, B.A.

DENTAL ADVISOR Microbiology Research Center
3110 West Liberty, Ann Arbor, MI 48103

Number 146 – February, 2021

Bacterial Reduction Efficacy of Nederman FX_2

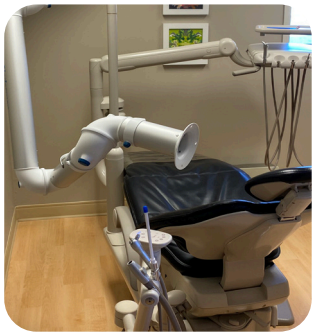
Clinician: Lesley Correll, B.S., RDH

Purpose:

To compare the ability of ***Nederman FX_2*** to reduce aerosols containing bacteria generated during ultrasonic scaling to that of a low-volume suction (SE) used independently, to represent the working conditions of many dental hygienists.

Challenge Device: ***Nederman FX_2*** can be configured to exhaust out of the building or recycled inside the building. The extraction arm has several flexible joints. Many attachments are available, including a large and small hood.

Device: Nederman FX_2



Experimental Design:

MATERIALS:

Nederman FX_2 (Nederman), standard SE suction tips, Cavitron ultrasonic scaling unit with Insert 10S FSI 30K (Dentsply Sirona), SAS Super 180 Bioaerosol Sampler, TSA with Lecithin and Poly 90 Contact Plates, DustTrak II Model 8532 Handheld, AirSense Particle Monitor, PTrak Ultrafine Particle Monitor, decibel meter, patient volunteers (A, B, C, D, E, F, G, and H), licensed dental hygienist volunteer wearing a Level 3 face mask and shield, gloves, and scrubs.

METHODS:

Each aerosol generating procedure was completed while the office was closed, and all procedures were completed in one designated operatory. Prior to the first patient, lines were cleaned with an evacuation line cleaner and traps were changed. Monarch Lines (Air Techniques) water treatment was utilized in a closed system (water bottle). Cavitron 300 Series Ultrasonic Scaler (Dentsply Sirona) was consistently set to 60Hz and was set at the highest water spray level using a Focused Spray 10 S Universal Insert. Before testing, all volunteers agreed to participate in the study and to having their photos taken. The same dental professional performed all procedures in this study. For each procedure, all quadrants of the mouth were treated; anterior and posterior, buccal and lingual.

The following sequence of conditions were consistent for all 8 patients during testing. First, a control sample was taken for 5.5 minutes while the patient and dental hygienist reviewed health history prior to aerosol generation. Condition two consisted of 5.5 minutes of ultrasonic scaling with ***Nederman FX_2*** turned on and placed 6 inches away from the patient's mouth opening. A low-volume suction (SE) was held by the patient in the lower left quadrant of the mouth for the duration of the procedure. Condition three consisted of 5.5 minutes of scaling without the use of ***Nederman FX_2***, and a low-volume suction was held by the patient in the lower left quadrant of the mouth for the duration of the procedure. During each of these 3 conditions for all 8 patients (24 separate sampling intervals), measurements were routinely taken using the SAS Super 180 Bioaerosol Sampler with a new TSA with Lecithin and Poly 90 Contact Plate placed 18 inches from the patient's mouth, the PTrack Ultrafine Particle Monitor attached to the shoulder of the dental hygienist, the DustTrak II Model 8532 Handheld that was embedded in the exhaust piping of ***Nederman FX_2***, and using the AirSense Particle Monitor placed in a fixed position to the left of the patient dental chair. There was a 10 to 30-minute room turnaround time between each patient, during which appropriate clinical contact surface cleaning and disinfection protocols were followed. The exposed TSA with Lecithin and Poly 90 Contact Plates were immediately processed and then incubated at 37°C for 48 hours. Microbial growth was quantified, analyzed and recorded for all plates. Measurements taken on the PTrak Ultrafine Particle Counter, the DustTrak II Model 8532 Handheld, and the AirSense Particle Monitor were downloaded, averaged for each 5.5-minute interval, and analyzed after testing.

Condition 1: Control

Condition 2: SE Alone

Condition 3: SE w/ FX_2

Results:

Data was analyzed by isolating each patient's comparative results due to the different microbiomes within each patient's mouth. The nature of aerosols as well as testing on real patients does not allow for direct comparative analysis of colony forming units (CFU) counts between patients. For all 8 patients, the bacterial load collected using the bioaerosol sampler was lower when using ***Nederman FX$_2$*** in conjunction with a low-volume suction (SE) compared to using a SE independently (Fig.1). For 7 of the 8 patients, the collected bacterial load from the bioaerosol sampler was lower using ***Nederman FX$_2$*** with a SE during aerosol generation compared to the control sample taken prior to any aerosol generation for each patient (Fig.1). Over the course of the study, all exhaust air measurements taken using the DustTrak II Model 8532 Handheld consistently stayed under 0.080mg/m^3 (Fig.2). The particle mass measurements of the exhaust air derived from the DustTrak when Nederman FX2 was in use and not in use are listed in Figure 2 below (Note: Device malfunctioned during the eighth patient's procedure resulting in absence of data). The decibel reading while ***Nederman FX$_2$*** was in use in conjunction with a low-volume suction (SE) and an ultrasonic scaler was 70 dB, and the low-volume suction (SE) alone used in conjunction with an ultrasonic scaler was 67 dB. Conjunctive utilization of ***Nederman FX$_2$*** added 3 decibels to the noise level of the procedure.

Figure 1: Collected Bacterial Load

SAS Super 180 Bioaerosol Sampler

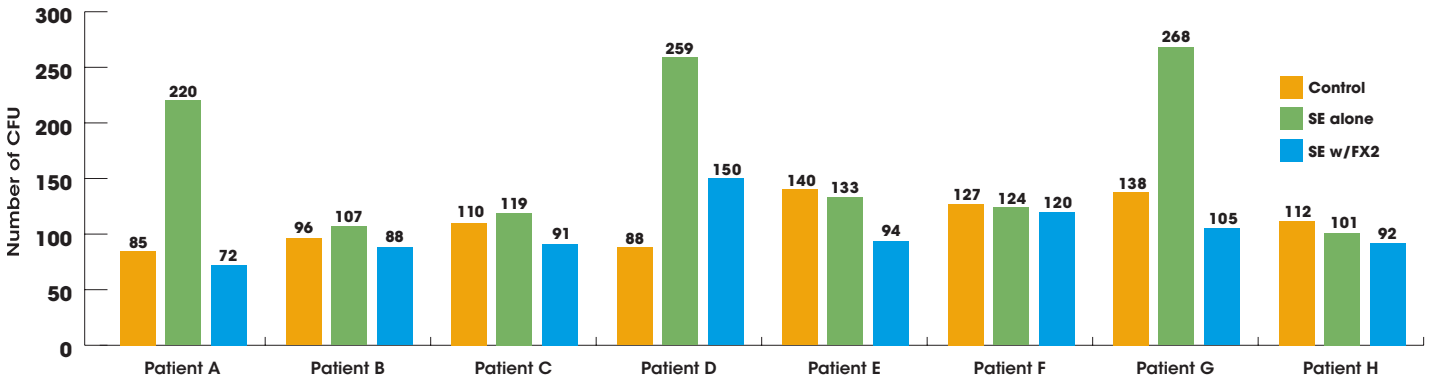


Figure 2: Exhaust Aerosol Mass Concentration

DustTrak II Model 8532 Handheld

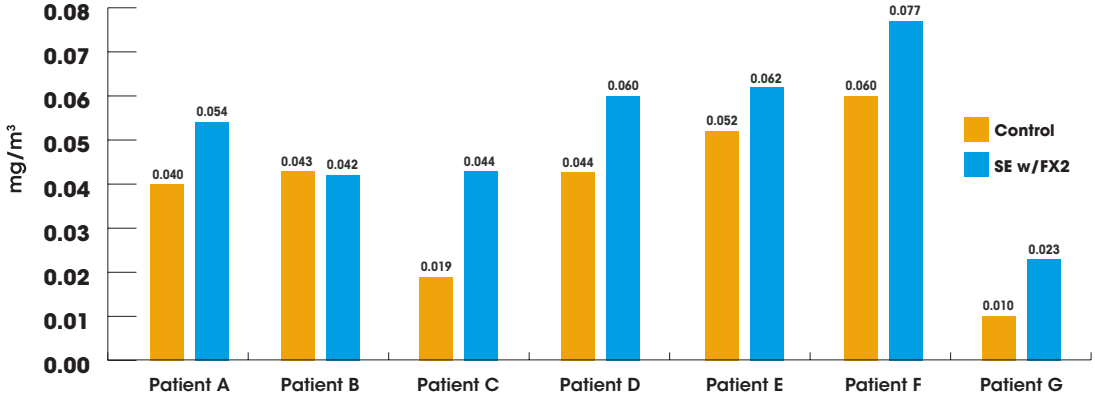
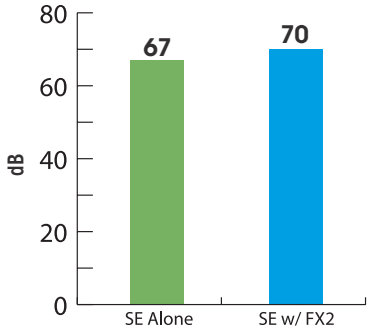


Figure 3: Decibel Output

Decibel Meter



Decibel meter in operatory

Discussion:

In this pilot study, the bioaerosol samples showed trends of reduced CFU counts when ***Nederman FX$_2$*** was in use compared to both the control and when using a SE independently during an ultrasonic scaling procedure. The results of this pilot study showed trends in favor of efficacy of ***Nederman FX$_2$***. Although there are no true standards for exhaust air safety, the goal of measuring the exhaust air was to find that the exhausted and filtered air would have lower mass concentrations than what was being pulled into ***Nederman FX$_2$*** during the procedure. The results of the exhaust air quality measurements showed trends of lower mass concentrations compared to the ambient air in the operatory and what was entering ***Nederman FX$_2$*** (data on file). The measurements noted were higher during the use of ***Nederman FX$_2$***; during use there was air flowing through the exhaust piping, unlike during the control when ***Nederman FX$_2$*** was not in use. The air in the exhaust piping during the control was therefore stagnant, and as expected, had a lower mass concentration. The 3-decibel increase while using ***Nederman FX$_2$*** was considered negligible. The operatory where procedures were performed was cleared of any additional personnel during testing procedures. Limitations in the pilot study included a small sample size.

Conclusion:

The use of ***Nederman FX$_2$*** resulted in reduced bacterial load derived from aerosols when compared to using a SE independently during an aerosol generating procedure.

Future Directions for Research:

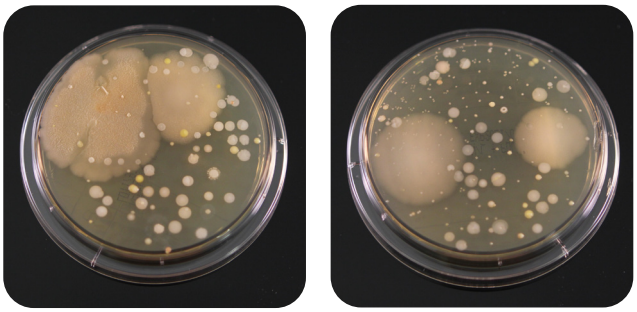
During this pilot study, additional measurements of air quality were performed using the AirSense particle monitor in a fixed 4 o'clock position to the patient chair and an ultrafine particle monitor attached to the shoulder of the hygienist. What was likely due to a variety of variables including surrounding activity, operatory layout, instrument limitations, sampling location, or other factors, this data was inconsistent and had a high degree of variability.

There are currently no dental practice specific guidelines for measuring or controlling the quality of operatory air due to the open concept design that is typical of most dental practices and the complexity of HVAC design. Much of the clean room analysis done in hospital settings is performed in a closed environment. Dental practices, unless performing dentistry in surgical suites, lack the design to control air quality. Due to these unique variables in operatory design, there is a large gap in the setting of consistent standards. Nederman and Dental Advisor will be working together in the future to identify and capture consistent control data based on dental operatory design. With this information future research can focus not only on ambient aerosol but also on particle measurements of restorative materials commonly used in dentistry.

Results Continued:

Patient A:

Nederman FX_2 | Saliva Ejector

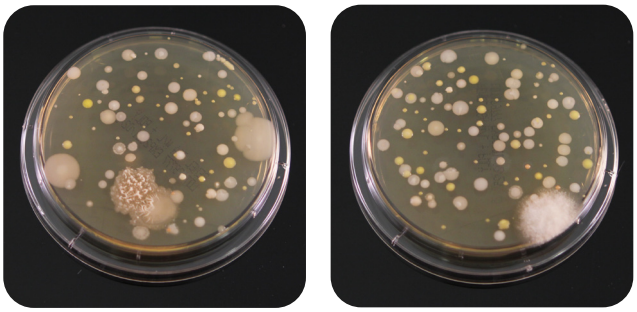


(CFU = 72) (CFU = 220)

Time interval between Patient A and B: 15 minutes

Patient B:

Nederman FX_2 | Saliva Ejector

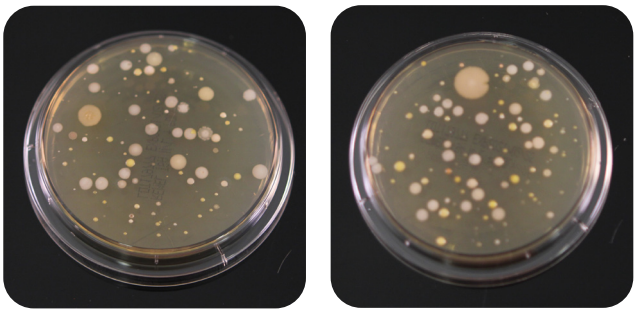


(CFU = 88) (CFU = 107)

Time interval between Patient B and C: 10 minutes

Patient C:

Nederman FX_2 | Saliva Ejector

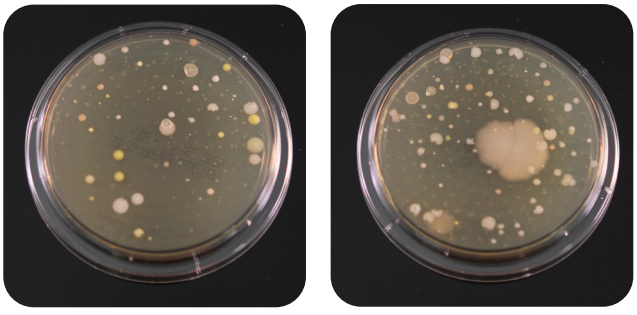


(CFU = 91) (CFU = 119)

Time interval between Patient C and D: 30 minutes

Patient D:

Nederman FX_2 | Saliva Ejector

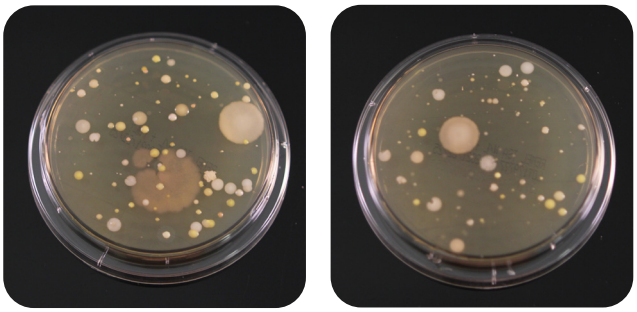


(CFU = 150) (CFU = 259)

Time interval between Patient D and E: 10 minutes

Patient E:

Nederman FX_2 | Saliva Ejector

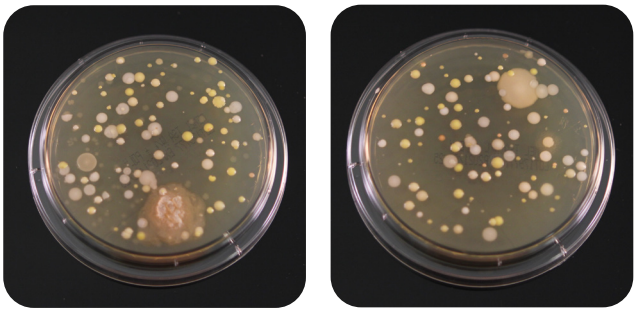


(CFU = 94) (CFU = 133)

Time interval between Patient E and F: 20 minutes

Patient F:

Nederman FX_2 | Saliva Ejector

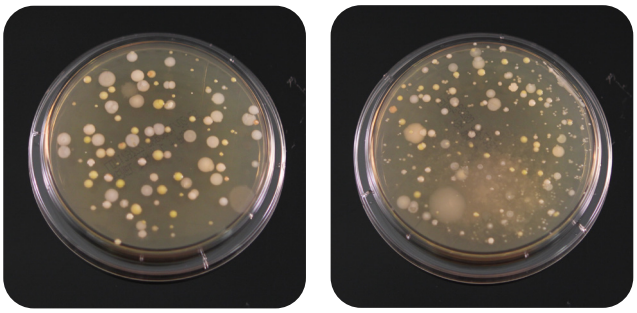


(CFU = 120) (CFU = 124)

Time interval between Patient F and G: 10 minutes

Patient G:

Nederman FX_2 | Saliva Ejector

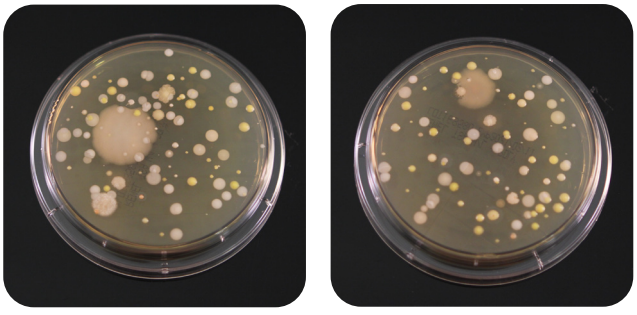


(CFU = 105) (CFU = 268)

Time interval between Patient G and H: 30 minutes

Patient H:

Nederman FX_2 | Saliva Ejector



(CFU = 92) (CFU = 101)

Clinician and Patient Feedback on Nederman FX_2

Clinician Comments:

- "Frankly, I expected the device to be much more obtrusive than it is. I barely noticed it was there."
- "I was surprised at how powerful the suction was, yet it was quiet."
- "This device is as easy to position as an x-ray head. It is out of the way when you need it, and easy to position where you need to."
- "Installation of the device was very clearly explained to me, including the filter in the mechanical room. It's easy to see that this will make a difference."
- "This is quiet and does not get in the way as I would expect. It makes sense to have it installed and piped out of the building."
- "My patients mentioned that the device made them feel safer."
- "The design of the arm is sleek and looks very aseptic. I might suggest making levers or poseable joints as opposed to dials you have to adjust. Something smoother would be easier to disinfect as well."
- "Personally, I preferred the smaller suction design. The shield was very large and would fog up. I couldn't get it to the exact position I wanted."

Nederman FX₂ folds compactly up against the wall.

Nederman FX₂ adjusts easily with knobs at each articulated joint.

The dentist continues to position the device closer to patient.

Nederman FX₂ HEPA filter is installed away from the patient area in the mechanical room.

Patient Comments:

- "Initially I was taken aback with something new, but once the hygienist explained what it was doing, it gave me relief that the office was considering safety during COVID."
- "The device looks space-age, clean, and appeared to do its job helping the hygienist. She was commenting how powerful it was."
- "I felt safer having this working as a secondary measure during my procedure. You never know what is in the air from other people."
- "I appreciated the extra steps the office was taking to protect me and their employees."
- "I commented that my older dentist didn't have one of these, and the hygienist replied that they were on top of all of the latest technologies to protect patients. I liked that."
- "I could literally see the spray from the ultrasonic going towards ***Nederman FX₂***; when it was off, I kept getting spray all over the safety glasses they had me wearing."
- "The device wasn't as loud as I anticipated and the suction power was noticeable as I was able to observe spray being pulled into the suction nozzle during the procedure."

The Combi Hood can be integrated with ***Nederman FX₂*** to allow for a larger source capture.

Hygienist and patient using ***Nederman FX₂*** during a scaling procedure.

Doctor and patient incorporating ***Nederman FX₂*** during a restorative appointment.

Ultrasonic scaling while using ***Nederman FX₂***.