Particle Topography Assessment in Simulated Restorative Dental Procedures

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Introduction

- This study demonstrates the effect of using water spray and high-volume suction on reducing aerosolized particle count and fallow time during routine dental procedures.
- Aerosols and droplets may carry and transport pathogens & viruses such as SARS-CoV-2.
- Droplets and splatter are larger than 10 µm and settle quicker and have a ballistic trajectory due to their large size[1].
- Aerosols are liquid and/or solid based particles smaller than 10 µm and can remain suspended in air for extended periods, for example, hours or even days[2].
- Aerosols may be inhaled by people and penetrate deeply into their lung.
- Dental care workers are at a much higher risk of disease transmission due to utilizing aerosol generating devices (AGDs)[3]. AGDs include air water syringe, ultrasonic scalar, and high-speed handpiece.

Hypothesis

- There is no difference in concentration of airborne particles produced when using a dental handpiece with or without water.

Purpose

- This study was designed to quantify the topography of aerosolized particles produced during simulated restorative procedures and to compare the particle concentration generated with and without water.

Acknowledgements

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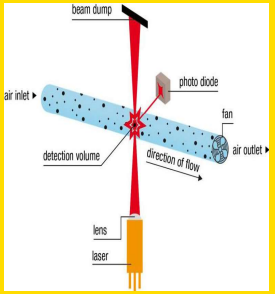
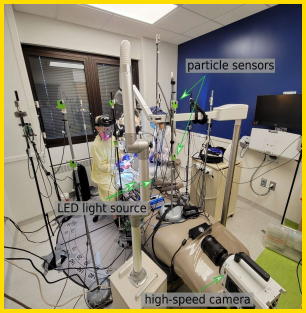
Materials & Methods

Operatory Setup



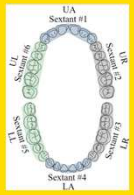
Schematic inside a PM sensor[4]



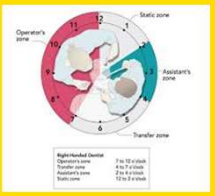
35 programmed/synced sensors

- A mannequin with a typodont setup in the dental chair
- A protractor under the dental chair to aide in systematically placing sensors.
- 35 air quality sensors - to evaluate PM10 aerosol particle (concentration of aerosolized particles ≤ 10 µm in size), besides temperature and humidity sensor.
- Prior to beginning the experiments, the initial particle count in the room was determined to be less than 10 particles/cm^3.

Simulated Dental Procedure Setup



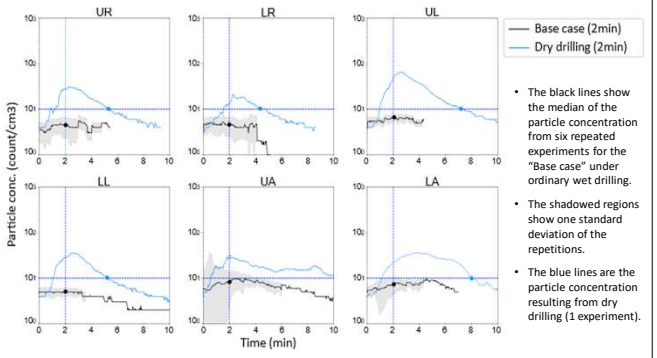
Typodont Sextant



Operator Positions[5]

- The operator was positioned in the 9 to 12 o'clock position and the dental assistant in the 1 to 3 o'clock position.
- Experiment baseline cases for each sextant simulating timed dental procedures:
  - one minute → one surface preparation
  - two minutes → three surface preparation
  - five minutes → full crown preparation

Results



- The black lines show the median of the particle concentration from six repeated experiments for the "Base case" under ordinary wet drilling.
- The shadowed regions show one standard deviation of the repetitions.
- The blue lines are the particle concentration resulting from dry drilling (1 experiment).

- Dry drilling created more particles than wet cutting throughout the 2-minute operation for all sextants.
- Average of median particle concentration of 6 repetitions during wet cutting was 4±2, 6±1, 5±2, 5±1, 7±6 and 6±3 particles/cm^3 for each sextant. Median of particles generated during dry cutting was 16, 23, 12, 19, 17, 22 particles/cm^3. Student t-test was performed and *P*-value < 0.05 was discovered for all sextants.
- Particles stay in the room for a longer period that may indicate longer fallow times.

Discussions

- The identification of effective and ineffective risk mitigation strategies can help dental providers make high impact changes.
- Future studies performed during actual dental procedures with sensors placed in the operatory will provide definitive data on the number of particles generated and the corresponding fallow time.

Conclusion

- Significantly more particles are generated and remain suspended for longer periods when dental handpiece is used without water.

References

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