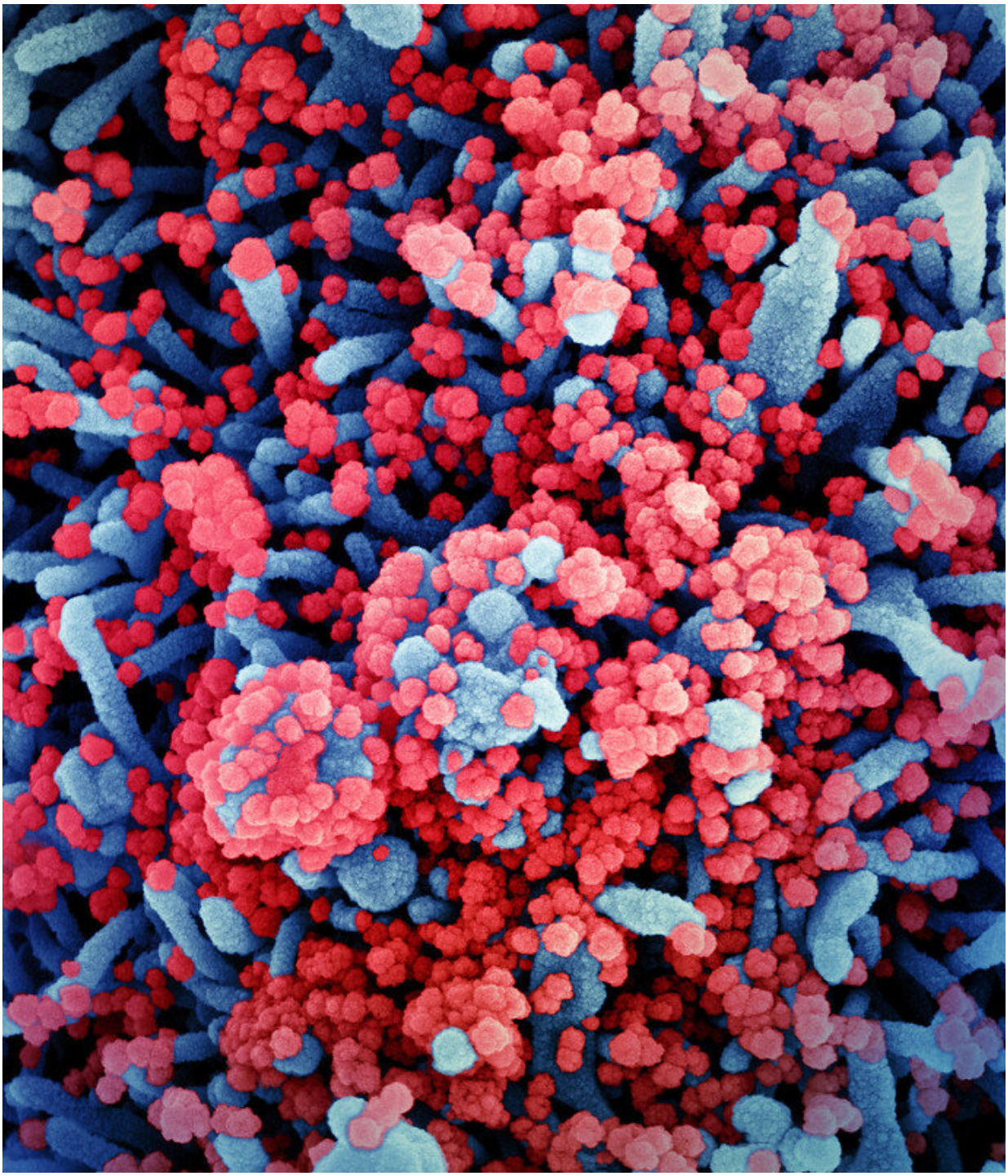
# Coronavirus spread during dental procedures could be reduced with slower drill rotation

December 17 2020



Colorized scanning electron micrograph of a cell (blue) heavily infected with SARS-CoV-2 virus particles (red), isolated from a patient sample. Image captured at the NIAID Integrated Research Facility (IRF) in Fort Detrick, Maryland. Credit: NIAID

Dental procedures can pose a high risk of viral transmission because the tools that are used often produce aerosols, which can contain high numbers SARS-CoV-2 virions, copies of the virus causing COVID-19.

The aerosols are generated when saliva mixes with water and air streams used in dental procedures. As a result, access to routine dentistry continues to be limited during the current COVID-19 pandemic.

Dental practices, which are now back in operation, have had to introduce new room decontamination processes and personal protective equipment measures which have dramatically reduced the number of patients that can be treated in a single day. In particular, dentists need to leave long intervals between treatments, leaving rooms unoccupied to allow aerosols to dissipate. This is limiting patient access and challenging financial feasibility for many dental practices worldwide.

Now, researchers at Imperial College London and King's College London have measured and analyzed aerosol generation during dental procedures and suggested changes to prevent contamination in the first place to improve safety for both patients and the dental practice workforce.

They suggest that dentists avoid using dental drills that use a mixture of air and water as the abrasion coolants, and carefully select and control drill rotation speeds for those instruments that only use water as a coolant. Parameters have been identified that would allow some procedures such as dental fillings to be provided whilst producing 60 times fewer aerosol droplets than conventional instrumentation.

Lead author Dr. Antonis Sergis of Imperial's Department of Mechanical Engineering said: "Aerosols are a known transmission route for the virus

behind COVID-19, so, with our colleagues at King's, we have tested suggested solutions that reduce the amount of aerosols produced in the first place. These could help reduce the risk of transmission during dental procedures."

Co-author Professor Owen Addison of King's College London's Faculty of Dentistry, Oral & Craniofacial Sciences said: "This important work describes the basic mechanisms that lead to the features of dental aerosols that we currently consider to be high risk. This has enabled us to choose drill parameters to keep our patients and the dental team safe at this difficult time. Although we cannot provide every procedure, because slowing our drills is much less efficient, we now have the basis to do more than we have done in the last 6 months."

The results are published today in *Journal of Dental Research* and are already being included as evidence in guides for dental practices in the UK during the pandemic. The collaborative research used the engineering expertise at Imperial and clinical expertise at King's College London's Faculty of Dentistry, Oral & Craniofacial Sciences.

The researchers used dental clinical rooms at Guy's Hospital in London to test how aerosols are generated during procedures such as decay removal, applying and polishing fillings and adjusting prostheses. They measured the aerosol generation using high speed cameras and lasers. They then used these findings to suggest modifications.

They found that using air turbine drill types, which are the most common type of dental drill, creates dense clouds of aerosol droplets that spread as fast as 12 metres per second and can quickly contaminate an entire treatment room. Just one milliliter of saliva from infected patients contains up to 120 million copies of the virus, each having the capacity to infect.

They tested a different type of drill, known as high torque electric micromotor, with and without the use of water and air streams. They found that using this drill type at low speeds of less than 100,000 rpm without air streams produced 60 times fewer droplets than air turbine drill types.

In addition, they found that aerosol concentration and spread within a room is dependent on the positioning of the patient, presence of ventilation systems, and the room's size and geometry. It is also influenced by the initial direction and speed of the aerosol itself, which can be affected by the type of cutting instrument (burr), and the amount and type of cooling water used.

The researchers say that by understanding how to reduce the amount of aerosol generated in the first place, their suggestions could help dentists practice more and help patients get the treatment they need.

They also note that patients should still not attend dental appointments if they have symptoms of COVID-19.

Professor Owen Addison from King's said: "Because of the COVID-19 pandemic, dentistry has become a high-risk practice—but the need for treatments hasn't gone away. Our suggestions could help begin to open up dentistry to patients once again."

Their suggestions have been included in the evidence appraisal in dentistry document entitled "Rapid Review of Aerosol Generating Procedures in Dentistry", published by the Scottish Dental Clinical Effectiveness Programme (SDCEP). The results from the study have also been considered by an expert task force convened by the Faculty of General Dental Practice (FGDP (UK)) and the College of General Dentistry and published in their guide entitled "Implications of Covid-19 for the safe management of general dental practice."

Co-author Professor Yannis Hardalupas of Imperial's Department of Mechanical Engineering said: "The impact of the results is significant. For example, the risk categorisation for dental procedures included in the FGDP (UK) document was certainly influenced by our work."

The team's research is ongoing. They are currently better assessing the risk of infection by quantifying the amount of saliva mixed into the generated aerosols by dental instruments.

'Mechanisms of atomization from rotary dental instruments and its mitigation' will be published 17 December 2020 in the *Journal of Dental Research*.

**More information:** A. Sergis et al. Mechanisms of Atomization from Rotary Dental Instruments and Its Mitigation, *Journal of Dental Research* (2020). DOI: 10.1177/0022034520979644

Provided by Imperial College London