

NUS Faculty of Dentistry research assistant Lekshmi Ravisankar checking tooth specimens at the National University Centre for Oral Health Singapore (NUCOHS) Tooth Tissue Bank. ST PHOTOS: KELVIN CHNG

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How Singapore's first Tooth Tissue Bank is advancing dental research.
str.sg/viz-tooth



1 A dentist at NUCOHS extracting a patient's third molar, also known as the wisdom tooth. The patient agreed to donate it to the Tooth Tissue Bank.



2 An extracted wisdom tooth from a donor. Donors are anonymous to researchers working on the extracted teeth.



3 Ms Hernani Abdullah, a senior dental surgery assistant, depositing a donated tooth in a cup in a utility room.

FANGS FOR DONATING

Singapore's first Tooth Tissue Bank was set up in 2021 to support research on teeth for various purposes, including developing more resilient filling materials and using stem cells to regenerate nerves and blood vessels in teeth. Here is a peek into what goes on behind the scenes.



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Journalist



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Imagine that you are a dental researcher about to conduct a study requiring 100 tooth samples. You would have to connect with dentists and dental clinics, explain your research and seek their cooperation. You would also have to ensure

that dentists properly inform patients about the study and obtain their consent, which includes explaining the purpose of the research. To add another layer of complexity, a researcher must also navigate ethical and legal requirements, obtaining approvals from institutional review boards or ethics committees.

Associate Professor Vincius Rosa of the Faculty of Dentistry at NUS says: "It would take months before we start collecting any teeth, and maybe years before we actually start on the project. It would be a time-consuming and tedious process, even before we begin the study." Singapore's first Tooth Tissue Bank speeds up this process by keeping a ready supply of teeth donated by patients after extraction. The teeth are available to researchers at the NUS Faculty of Dentistry and National University Centre for Oral Health Singapore (NUCOHS) for their projects. The NUCOHS Tooth Tissue Bank was established in 2021 by the cen-

tre, with the support of the NUS Faculty of Dentistry. On days when an extraction is scheduled at NUCOHS, the faculty's Clinical Research Unit reaches out to the dentist in charge of the procedure.

The dentist then invites the patient to donate the extracted tooth and, if the patient agrees, it is collected for the Tooth Tissue Bank. "About 40 per cent of patients are willing to donate their extracted tooth and the rest either prefer to take it home or discard it," says Prof Rosa.

Donors are anonymous to researchers working on the extracted teeth. On the day of the photo shoot, The Straits Times speaks to X, who was scheduled to have a third molar, also known as the wisdom tooth, extracted, to find out why the patient agreed to the donation. "I see no purpose in keeping or discarding my extracted tooth. Donating it helps with important dental research and contributes to advancements in dental science," says the patient.

Two research coordinators from the Clinical Research Unit are tasked to collect the extracted teeth at the end of the day. Their responsibilities involve decontaminating the teeth by soaking them in a solution containing alcohol before transferring them into a test tube. The test tube is then placed in a box and transported to a fridge in the Tooth Tissue Bank, which is located in NUCOHS in Lower Kent Ridge Road.

"The fridge temperature is set at 4 deg C - a good temperature to prevent the growth of bacteria," says Ms Nur Ashira Abdul Rahman, a research laboratory technologist at the faculty.

The fridge houses jars of teeth sorted according to their types: incisors, canines, premolars and molars. Ms Ashira is responsible for cleaning and sorting the teeth, and replacing the water in the jars weekly.

Cleaning is a manually intensive process that starts with rinsing the teeth in highly purified water. She then uses tweezers to remove blood, tartar, plaque and other debris. This can take up to 15 minutes per tooth.

The teeth are sorted into two main categories after cleaning: restored teeth and those that are perfect or close to perfect and unharmed by decay or filling. The tooth samples have to be further processed to meet the requirements and exact measurements needed for different research projects, says Prof Rosa.

The first step in processing a tooth is to cut it into thin slices using a machine with a mechanised circular blade that is sharp and fragile. "The tooth enamel is the hardest tissue in the body, even harder than bone," says Prof Rosa. Any unexpected vibration during the cutting will cause both the tooth and the blade to be damaged. It takes a lot of training to slice a tooth down to a few millimetres, says Prof Rosa.

The edges are then trimmed so that each tooth slice becomes a small rectangle, which is ideal for some projects. Depending on the project requirements, a slice might be trimmed into an oval or square shape. Each slice can take up to two hours to perfect, he notes. With a ready supply of extracted teeth, researchers are ready for work.

One of the projects that Prof Rosa has been working on is the use of stem cells from extracted teeth to regenerate tooth pulp - the soft, innermost part of the tooth containing nerves, blood vessels and connective tissues.

While root canal treatments are effective at stopping infection and saving the tooth structure, they remove the pulp and replace it with mostly synthetic materials, leaving the tooth essentially "dead".

"Dental pulp tissue engineering aims to change that by using natural biological materials to keep the tooth alive and healthy by rebuilding the dental pulp," says Prof Rosa.

By using stem cells harvested from the pulp of extracted teeth, researchers hope to fill the empty pulp chamber with living tissues that can repair themselves, respond to damage and maintain the tooth's health.

"This could keep the tooth alive and healthy and capable of fighting off future infections or injuries, unlike current root canal treatments that leave the tooth lifeless," says Prof Rosa.

He adds that the concept of pulp regeneration is currently being tested in clinical trials across the world, but it will take several years before the procedure is introduced in dental clinics.

Researchers at the NUS Faculty of Dentistry are also working to improve the strength of the bonding materials for dental restorations, like fillings and crowns. "New materials are constantly being developed and these need to be tested to ensure they adhere well, are durable and safe," says Prof Rosa.

In five to 10 years, he hopes that the bank will expand its collection to include tissues from biopsies, stem cells and saliva. "As dental science continues to evolve, the contributions of the Tooth Tissue Bank will remain pivotal in shaping the future of oral healthcare," says Prof Rosa.

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4 Each tooth is soaked in an alcohol solution to decontaminate it before it is transferred into a test tube with highly purified water. The test tube is then placed in a box.



5 After decontaminating the teeth, NUS Faculty of Dentistry clinical research coordinator Celeste Tan transports the box with the test tubes of teeth to the Tooth Tissue Bank's fridge.



6 Ms Nur Ashira Abdul Rahman, a research laboratory technologist at the NUS Faculty of Dentistry, checking and cleaning the teeth at a biosafety cabinet.



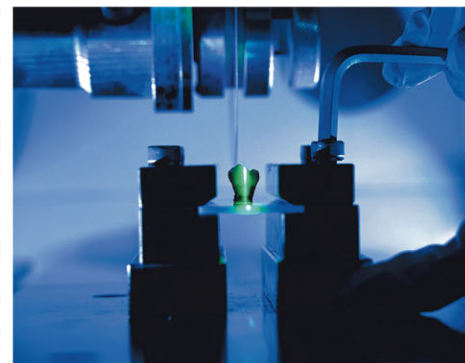
7 Ms Ashira pouring the teeth into a metal strainer and draining the solution before checking and cleaning them at the biosafety cabinet.



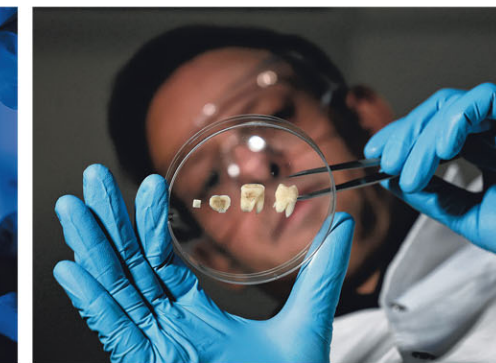
8 Ms Ashira at the Tooth Tissue Bank's fridge, which houses jars of teeth sorted according to their types: incisors, canines, premolars and molars.



9 A test being conducted on the force required to remove dental fillings by shear stress on a tooth. This is done by simulating the biting action, which will cause the filling to fall off.



10 Above: To prepare sample slices for researchers, a tooth is secured on a precision cutter, where a laser beam measures the angle at which to slice the tooth. Any unexpected vibration during the cutting will cause both the tooth and the blade to be damaged.



11 Above: Associate Professor Vincius Rosa of the Faculty of Dentistry at NUS checking tooth specimens at different stages of preparation.



12 Left: Prof Rosa (right) working alongside a researcher in the laboratory.