

CAN NANOBOTS DEEP CLEAN TEETH?

Relevant for: Science & Technology | Topic: Nanotechnology

Mechanism: Nanobots generate heat to kill the bacteria, leaving the surrounding healthy tissue undamaged, says Shanmukh Srinivas (middle). | Photo Credit: Special Arrangement

Few things are as shorn of complexity as the root canal treatment so much so that the basic principles of performing them have been unchanged from the times Romans inserted bronze wires into their teeth to treat the infection.

Once the shooting pain has been diagnosed as being due to a bacterial infection within the tooth, the dentist drills a hole, scoops out the infected pulp, disinfects the tooth and fills the space with an antibacterial sealant like bleach or hydrogen peroxide.

The hope is that the job is thorough and the vanquished bacteria doesn't rejuvenate. Estimates from the United States suggest that of the 35 million dental procedures to treat a root canal, about 10% are failures.

A common cause of failure is that the underlying bacteria, usually *Enterococcus faecalis*, hasn't been completely eliminated paving the way for reinfections that can necessitate extracting the tooth.

The quest to deliver enough antibacterial agent to the depths of the tooth has in recent years seen extremely sophisticated, complex, cutting-edge approaches that make the conventional RCT appear not just pre-Roman but even Stone Age.

Rather than the dentist's drill, a fine beam of light pushes an antibacterial deep into the tooth's passageway in this approach. Another is to use ultrasound waves to, again, make the antibacterial go deeper. Some early experiments with lasers attempted to do away with pushing antimicrobials altogether and use the heat from ultra-thin light beams to incinerate the bacteria.

But the equipment, expertise and the risk of harming healthy tissue makes these approaches a rarity, particularly in Indian dental clinics. But Theranutilus, a Bengaluru based start-up incubated at the Indian Institute of Science, aspires to go one up by employing nanotechnology. By deploying an army of so called 'nanobots', or tiny 'robots' that are helical crawlers made of silicon dioxide coated with iron, the aim is to have the bots move as close to where the bacteria abound.

The bots' movement can be controlled using a device that generates a low intensity magnetic field. In their tests, Theranutilus scientists injected these nanobots into extracted tooth samples and tracked their movement via a microscope. By manipulating the frequency of the magnetic field, the nanobots could be made to move at will, and penetrate deep inside the dentinal tubules. The dentist can control the movement of billions of these nanobots, each no more than 300 nanometres (1,000 times thinner than hair) and take them to the site of the bacterial infection. Working in tandem, these nanobots can generate enough heat to kill the bacteria but not damage surrounding healthy tissue, said Shanmukh Srinivas, a dentist and co-founder of the company.

A research report by Theranutilus scientists in the journal *Advanced Healthcare Materials* says that tests on mice revealed the use of nanobots as safe.

Mr. Srinivas said that the next step ahead will be to test the device in people via clinical trials and the company is in the process of tying up with hospitals for the same. "Were everything to go to plan, we expect that this treatment will be available at the clinic in four-five years," he added.

Their research paper says that while nanobot-heat eliminated the bacteria, there was a possibility that some bacteria could remain and therefore the nanobots could even be used as drug delivery vehicles to transport antibacterial material.. The amount of silica in every dose of treatment was less than that in a pint of beer, according to Mr. Srinivas, and was extremely safe.

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