Nanodiamonds might help prevent tooth loss after root canals

*UCLA research shows the particles enhance gutta-percha strength and infection control*

People undergoing root canals may have gained a powerful, if tiny, new ally. Researchers from the UCLA School of Dentistry have found that using nanodiamonds to fortify a material used in the procedure could significantly improve outcomes for patients.

A paper on their research is published in a recent issue of the peer-reviewed journal ACS Nano.

Nanodiamonds are tiny particles formed as byproducts of diamond refining and mining. Thousands of times smaller than the width of a human hair, they have been widely explored for use in dentistry, cancer therapy, imaging and regenerative medicine, among other applications.

Each year, more than 15 million root canal procedures are performed in the United States. Dentists’ goal is to save their patients’ teeth from infected dental pulp. During a root canal, inflamed dental pulp is removed and the empty space is then filled in with gutta-percha, which is used in part because it does not react within the body. But some root canals don’t entirely remove the infection, and residual infection after root canals can lead to tooth loss.

In addition, traditional gutta-percha can have certain shortcomings, including a limited capacity to ward off infection and less-than-optimal rigidity.

To overcome those issues, the UCLA team developed and tested two types of reinforced gutta-percha: one strengthened with nanodiamonds and another strengthened with nanodiamonds that had been pre-loaded with antibiotics.

To evaluate the first type, study co-authors Sue Vin Kim and Adelheid Nerisa Limansubroto, UCLA School of Dentistry students, filled actual teeth from human patients. Using conventional radiography and micro-computed tomography, or micro-CT, they showed that the nanodiamond-enhanced gutta-percha could be used to fill the tooth.

Like the traditional formulation, the nanodiamond-enhanced compound did leave small gaps in the canal — where nanodiamonds might help prevent tooth loss after root canals.
Supercharged with amoxicillin

In the research’s second phase, the scientists tested nanodiamonds that had been loaded with amoxicillin, a broad-spectrum antibiotic used to combat infection. The drug-reinforced nanodiamonds, when combined with the gutta-percha, effectively prevented bacteria growth.

“The nanodiamond-enhanced gutta-percha combines many desirable properties into a single platform, including vastly improved mechanical characteristics and the ability to combat bacterial infection following a root canal,” said Dong-Keun Lee, a postdoctoral scholar in Ho’s lab.

The study involved UCLA researchers with expertise in a wide range of disciplines — materials science, nanotechnology, drug delivery, toxicology, oral radiology, endodontics, microbiology and other fields.

“Through their ingenuity and collaboration, Professor Ho’s team is poised to transform the way that dentistry is practiced,” said Dr. No-Hee Park, dean of UCLA Dentistry and a co-author of the study.

During the next two years, the team plans to optimize the formulation of the nanodiamond-reinforced gutta-percha and begin clinical trials at UCLA.

Ho is also a professor of bioengineering and member of the UCLA Jonsson Comprehensive Cancer Center and the California NanoSystems Institute at UCLA. Other authors of the study were Albert Yen of the UCLA department of bioengineering and UCLA School of Dentistry, and Akivroula Soundia, Yong Kim, We-nyuan Shi, Dr. Christine Hong, Dr. Sotiris Tetradis, Dr. Cun-Yu Wang and Dr. Mo Kang, all of UCLA School of Dentistry.

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(Source: UCLA School of Dentistry)