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-ideal 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, Sue Vin Kim and Adelheid Nerisa Limansubroto, study co-authors who are 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

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-ideal 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, Sue Vin Kim and Adelheid Nerisa Limansubroto, study co-authors who are 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
harmful bacteria could grow — but the CT imaging showed that the enhanced material filled the space just as effective-
ly as traditional gutta-percha. “Validating this novel material in teeth extracted from patients serves as a strong foundation for the potential translation of nanodiamond-reinforced gutta-percha toward clinical testing,” said Dean Ho, a senior author of the study and a professor of oral biology and medicine and co-director of UCLA Den-
tistry’s Jane and Jerry Weintraub Center for Reconstructive Biotechnology.
Supercharged with amoxicillin In the research’s second phase, the sci-
entists tested nanodiamonds that had been loaded with amoxicillin, a broad-
spectrum antibiotic used to combat infection. The drug-reinforced nanodi-
amonds, when combined with the gutta-
percha, effectively prevented bacteria growth. “The nanodiamond-enhanced gutta-
percha combines many desirable prop-
erties into a single platform, including vastly improved mechanical character-
istics and the ability to combat bacte-
rial 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 disci-
plines — materials science, nanotechnol-
gogy, drug delivery, toxicology, oral radi-
ology, endodontics, microbiology and other fields. “Through their ingenuity and collabo-
ration, Professor Ho’s team is poised to transform the way that dentistry is prac-
ticed,” 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 Com-
prehensive Cancer Center and the Cali-
ifornia NanoSystems Institute at UCLA. Other authors of the study were Albert Yan of the UCLA department of bioengi-
neering and UCLA School of Dentistry, and Akrivoula Soundia, Yong Kim, We-
nyuan Shi, Dr. Christine Hong, Dr. Sonin-
os Tetradis, Dr. Cun-Yu Wang and Dr. Mo.
Kang, all of UCLA School of Dentistry. The study was supported by the Na-
tional Cancer Institute, the National Sci-
ence Foundation, the Wallace H. Coulter Foundation, the V Foundation for Cancer Research, the Society for Laboratory Au-
tomation and Screening, and Beckman Coulter Life Sciences.
(Source: UCLA School of Dentistry)