# Nanotechnology could redefine oral surgery

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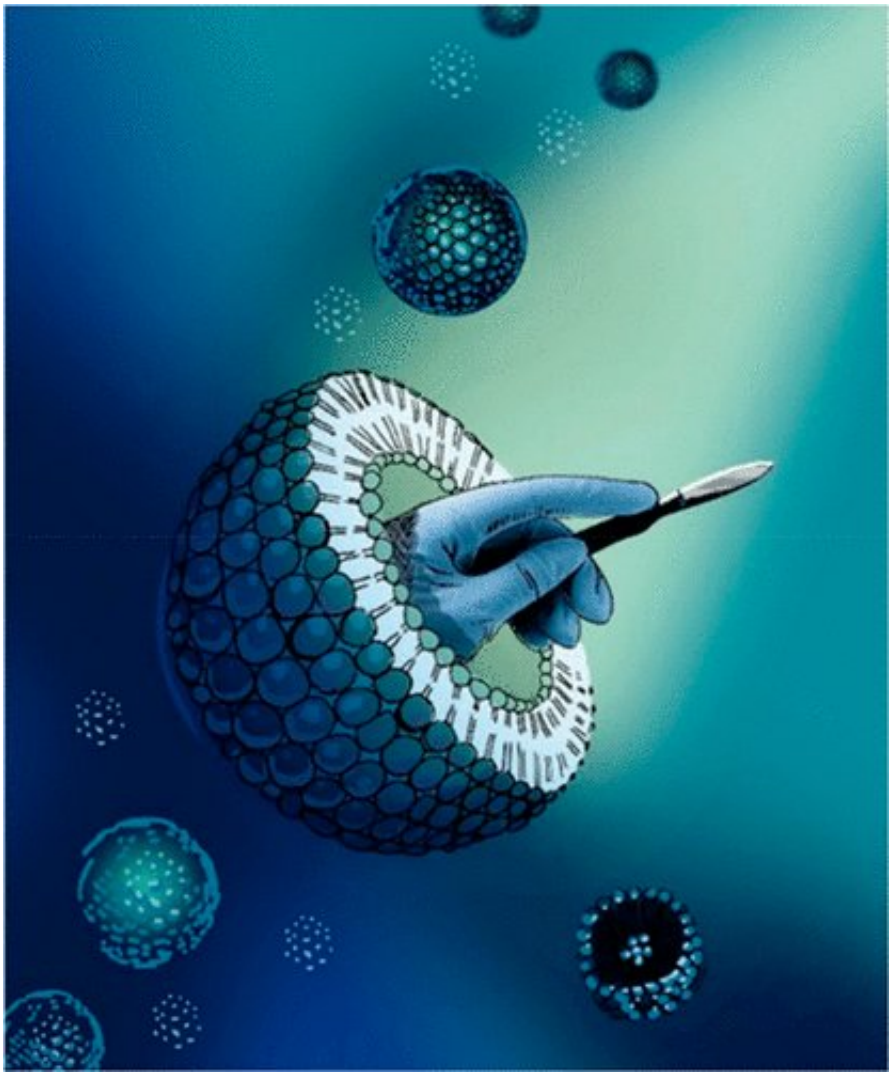

Credit: American Chemical Society

A trip to the dentist or orthodontist usually instills a sense of dread in

most patients, and that's before the exam even begins. Add to that the fear of oral surgery with a painful recovery, and many people will avoid these visits at all costs. Now, one group reports a pre-clinical study in *ACS Nano* showing that they could potentially reduce pain and recovery time with the aid of specialized nanotechnology.

Every year, 5 million people undergo orthodontic procedures in the U.S., according to the American Association of Orthodontists. In some cases, teeth are misaligned to such an extent that surgery is required to cut collagen fibers under the gums before braces are put on the teeth. But patients often choose not to undergo the procedure because it's invasive and can be painful. Scientists recently have turned to nanotechnologies to target therapeutics to specific locations. For example, previous studies have shown some success in using liposomes, which are empty nanoscale vesicles, for drug delivery. Collagenase enzymes could potentially remodel the fibers connecting teeth to bone in the mouth without using a scalpel, but so far, delivering enzymes with liposomes has been challenging. Avi Schroeder and colleagues wanted to develop liposomes that could deliver collagenase enzymes to perform targeted nanosurgery in the mouth.

The team developed liposomal nanoparticles that contained collagenase and performed tests with them in rats. When the liposomes were placed under the gums, the collagenase diffused out of the particles and was activated by calcium naturally found in the mouth. The collagenase weakened the collagen fibers, making it easier to shift the teeth afterward with braces. Compared to conventional surgery, the collagenase treatment helped move the teeth three times faster. All of the rats lost some weight after the surgery, just as humans typically do. But unlike the other rats, the ones treated with collagenase quickly rebounded to their normal healthy weight, which the researchers say suggests they were not in pain.

**More information:** Assaf Zinger et al. Proteolytic Nanoparticles Replace a Surgical Blade by Controllably Remodeling the Oral Connective Tissue, *ACS Nano* (2018). DOI: 10.1021/acsnano.7b07983

## Abstract

Surgical blades are common medical tools. However, blades cannot distinguish between healthy and diseased tissue, thereby creating unnecessary damage, lengthening recovery, and increasing pain. We propose that surgical procedures can rely on natural tissue remodeling tools—enzymes, which are the same tools our body uses to repair itself. Through a combination of nanotechnology and a controllably activated proteolytic enzyme, we performed a targeted surgical task in the oral cavity. More specifically, we engineered nanoparticles that contain collagenase in a deactivated form. Once placed at the surgical site, collagenase was released at a therapeutic concentration and activated by calcium, its biological cofactor that is naturally present in the tissue. Enhanced periodontal remodeling was recorded due to enzymatic cleavage of the supracrestal collagen fibers that connect the teeth to the underlying bone. When positioned in their new orientation, natural tissue repair mechanisms supported soft and hard tissue recovery and reduced tooth relapse. Through the combination of nanotechnology and proteolytic enzymes, localized surgical procedures can now be less invasive.

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