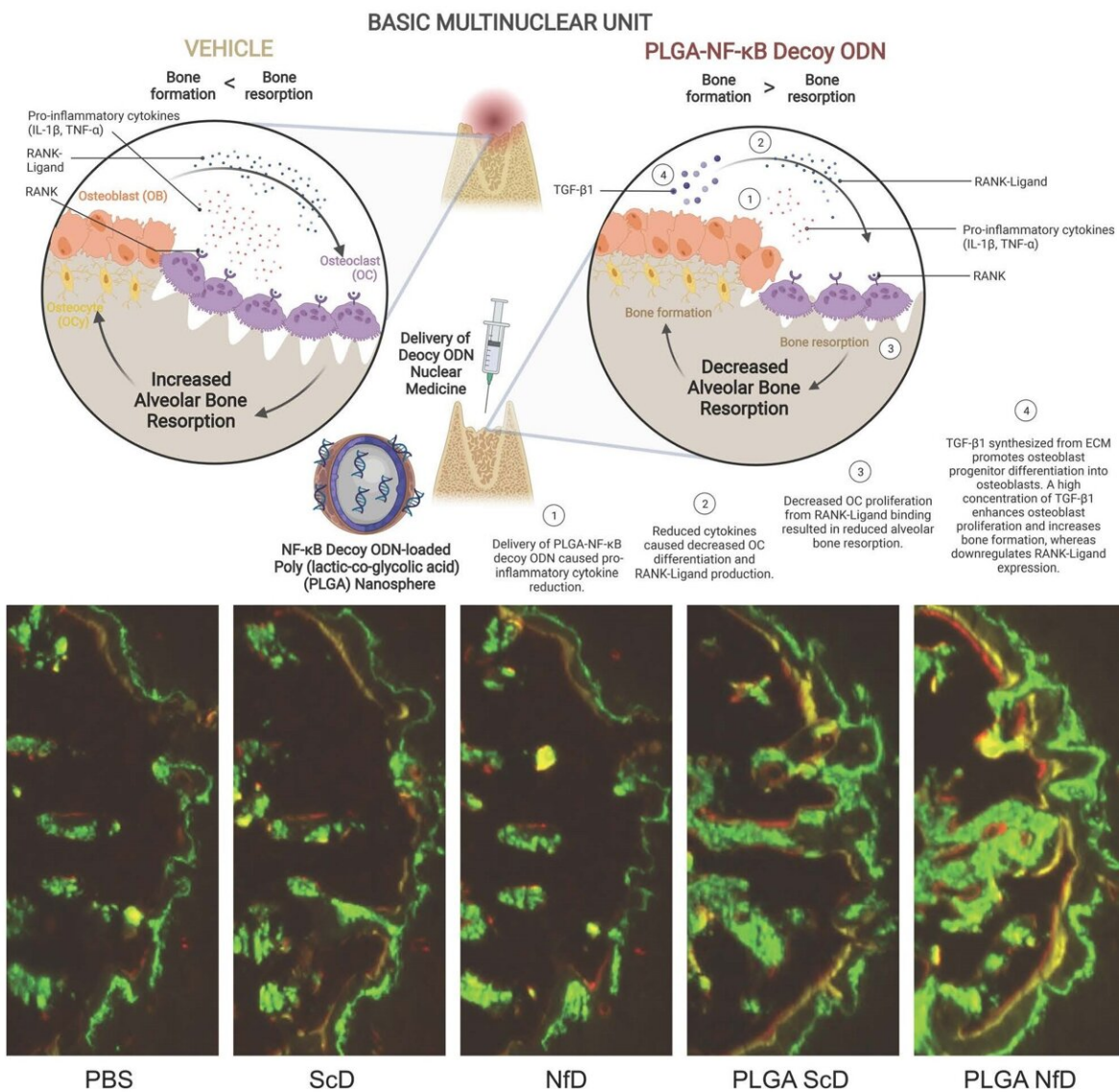


How a polymeric nanoparticle gene delivery system can promote bone formation

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Prophylactic treatment of NF- κ B decoy ODN-loaded PLGA nanoparticles local

administration prevents alveolar bone loss and promotes wound healing after tooth extraction. PLGA-NfD demonstrates inhibitory effect on osteoclast differentiation and inflammatory cells (Upper), including the reduction of alveolar bone resorption, thereby allowing the continuing dynamic healing potential to accelerate new bone formation in the extraction socket, as assessed by bone-labeling technique with calcein (green), demeclocycline hydrochloride (yellow), and alizarin complexone (red) (Lower). Abbreviations: NfD, naked NF- κ B decoy; NF- κ B, nuclear factor-kappa B; ODN, oligodeoxynucleotide; PBS, phosphate-buffered saline; PLGA, poly(lactic-co-glycolic acid); PLGA-NfD, NF- κ B decoy ODN-loaded PLGA nanosphere; PLGA-ScD, scrambled decoy ODN-loaded PLGA nanosphere; ScD, naked scrambled decoy. Credit: Department of Orthodontic Science, TMDU

Does a "magic bullet" exist in regenerative medicine? Researchers have long wished to design a cutting-edge gene therapy that regenerates tissues damaged by disease or trauma. That wish may come true now that a research team has developed a polymeric gene delivery therapy that promotes new bone formation after traumatic inflammation.

In a study published in the *International Journal of Molecular Sciences*, researchers from Tokyo Medical and Dental University (TMDU) have revealed that a gene delivery therapy can effectively suppress inflammation to enhance tissue healing after [tooth](#) extraction.

Tooth extraction is a common surgical procedure in dental medicine. When a tooth is removed, sores are formed on the socket, which triggers a physiological healing process involving the reconstruction of damaged soft and hard tissues. One phase of wound healing, known as hemostasis, begins by stopping the bleeding from [blood clots](#), which stimulates an inflammatory phase.

This can help prevent further bleeding, but complications can arise if

prolonged. After tooth extraction, excessive inflammation can cause residual ridge resorption (reduction of the residual bone in the jaw), which can induce a negative and aggravating impact on dental surgery.

Bone remodeling, which occurs throughout life, is mediated by a [signaling pathway](#) that involves the protein complex NF- κ B (nuclear factor-kappa B). It controls the production of [genes](#) that regulates inflammation and bone healing. "Inhibitors of NF- κ B are widely recognized in the treatment of bone resorption; however, the application of an NF- κ B decoy oligodeoxynucleotide (ODN) is poorly investigated," explains lead author Takashi Ono.

In this study, tooth extraction was conducted using molar extraction surgery. A gene/drug delivery system was developed utilizing an efficient copolymer vector—a type of poly(Lactic-co-glycolic Acid)—to deliver NF- κ B decoy ODNs (double-stranded DNA fragments) to the extraction socket of rats and their therapeutic effects were investigated. It was found that the local administration of NF- κ B decoy ODNs using a copolymer vector effectively inhibited [bone resorption](#) and promoted bone formation at the extraction socket.

Additionally, gene delivery therapy prevented excessive inflammation. "This is the first in-vivo study revealing the efficacy of NF- κ B decoy ODNs administered by a copolymer vector to promote [bone](#) healing after tooth extraction," says Ono.

The findings of this study may lead to innovative gene therapy to prevent residual ridge resorption after surgical tooth [extraction](#).

More information: Albert chun-shuo Huang et al, NF- κ B Decoy ODN-Loaded Poly(Lactic-co-glycolic Acid) Nanospheres Inhibit Alveolar Ridge Resorption, *International Journal of Molecular Sciences* (2023). [DOI: 10.3390/ijms24043699](https://doi.org/10.3390/ijms24043699)

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