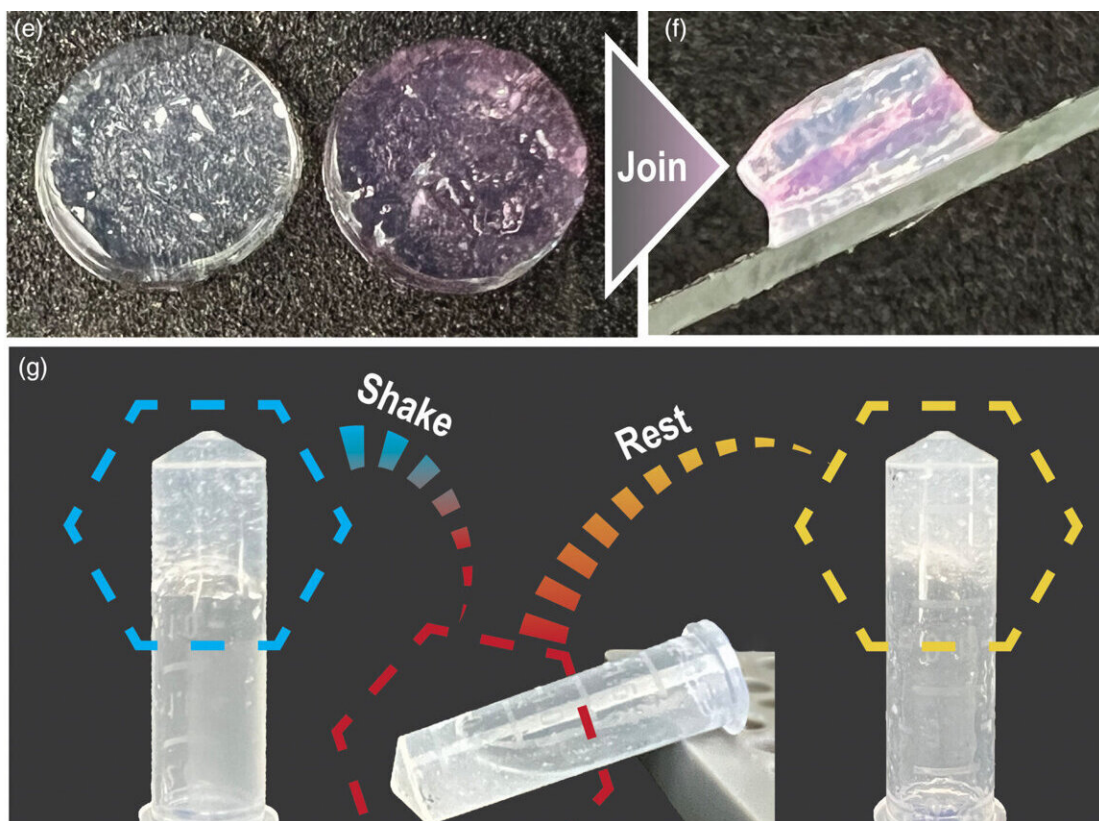


# Researchers induce bone regeneration with a special hydrogel that mimics the bone's natural environment

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Rheological and Fourier-transform infrared (FTIR) analyses of FmocFF/hyaluronic acid (HA) composite hydrogel. (a) FTIR spectra of FmocFF/HA, FmocFF and HA. (b) In situ time-sweep oscillation measurements of the FmocFF, HA, and the composite FmocFF/HA hydrogel. (c) Viscosity versus shear rate of the FmocFF/HA composite hydrogel. (d) Time sweep when alternate step strain switched from 0.1% to 100%. (e and f) Digital images

demonstrating the self-healing properties of separate layers of the composite hydrogel. (g) Inverted test tube showing the self-healing property of the hydrogel after mechanical breaking. Credit: *Journal of Clinical Periodontology* (2022). DOI: 10.1111/jcpe.13725

An innovative technology developed at Tel Aviv University may enable bone regeneration to correct large bone defects by means of a special hydrogel. Following successful tests in an animal model, the researchers now plan to move forward to clinical trials.

The study was conducted by experts from TAU's Maurice and Gabriela Goldschleger School of Dental Medicine, led by Prof. Lihi Adler-Abramovich and Dr. Michal Halperin-Sternfeld, in collaboration with Prof. Itzhak Binderman, Dr. Rachel Sarig, Dr. Moran Aviv, and researchers from the University of Michigan in Ann Arbor. The paper was published in the *Journal of Clinical Periodontology*.

Prof. Adler-Abramovich says that "small [bone](#) defects, such as fractures, heal spontaneously, with the body restoring the lost bone tissue. The problem begins with large bone defects."

"In many cases, when substantial bone loss results from tumor resection (removal by surgery), [physical trauma](#), tooth extraction, gum disease or inflammation around dental implants, the bone is unable to renew itself. In the current study, we developed a hydrogel that mimics the natural substances in the extracellular matrix of bones, stimulating bone growth and reactivating the immune system to accelerate the healing process."

The researchers explain that the extracellular matrix is the substance surrounding our cells, providing them with structural support. Every type of tissue in our body has a specific extracellular matrix consisting of

suitable substances with the right mechanical properties. The new hydrogel has a fibrillary structure that mimics that of the extracellular matrix of the natural bone. Furthermore, it is rigid, thus enabling the patient's cells to differentiate into bone-forming cells.

"As can be expected, the [extracellular matrix](#) of our bones is quite rigid," says Prof. Adler-Abramovich. "In our study, we produced a hydrogel that mimics this specific matrix in both chemical and physical properties. At the nanometric level, the cell can attach itself to the gel, gaining structural support and receiving relevant mechanical signals from the fibers."

"At first, to test these properties, we grew cells in a 3D model of the gel. Then we examined the impact of the hydrogel on model animals with large bone defects that could not heal spontaneously. We monitored them for two months with various methods, including Micro C.T. To our delight, the bone defects were fully corrected through regeneration, with the bones regaining their original thickness, and generating new blood vessels."

According to Prof. Adler-Abramovich, the innovative gel has extensive clinical applications in both orthopedic and [dental medicine](#). "When we lose teeth due to extensive damage or bacterial infections, the standard treatment is [dental implants](#). Implants, however, must be anchored in a sufficient amount of bone, and when [bone loss](#) is too substantial, physicians implant additional bone from a healthy part of the body—a complex medical procedure."

"Another option is adding bone substitutes from either human or animal sources, but these might generate an immune response. I hope that in the future the hydrogel we have developed will enable faster, safer, and simpler bone restoration."

**More information:** Michal Halperin-Sternfeld et al, Immunomodulatory fibrous hyaluronic acid- Fmoc -diphenylalanine-based hydrogel induces bone regeneration, *Journal of Clinical Periodontology* (2022). [DOI: 10.1111/jcpe.13725](https://doi.org/10.1111/jcpe.13725)

Provided by Tel-Aviv University

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