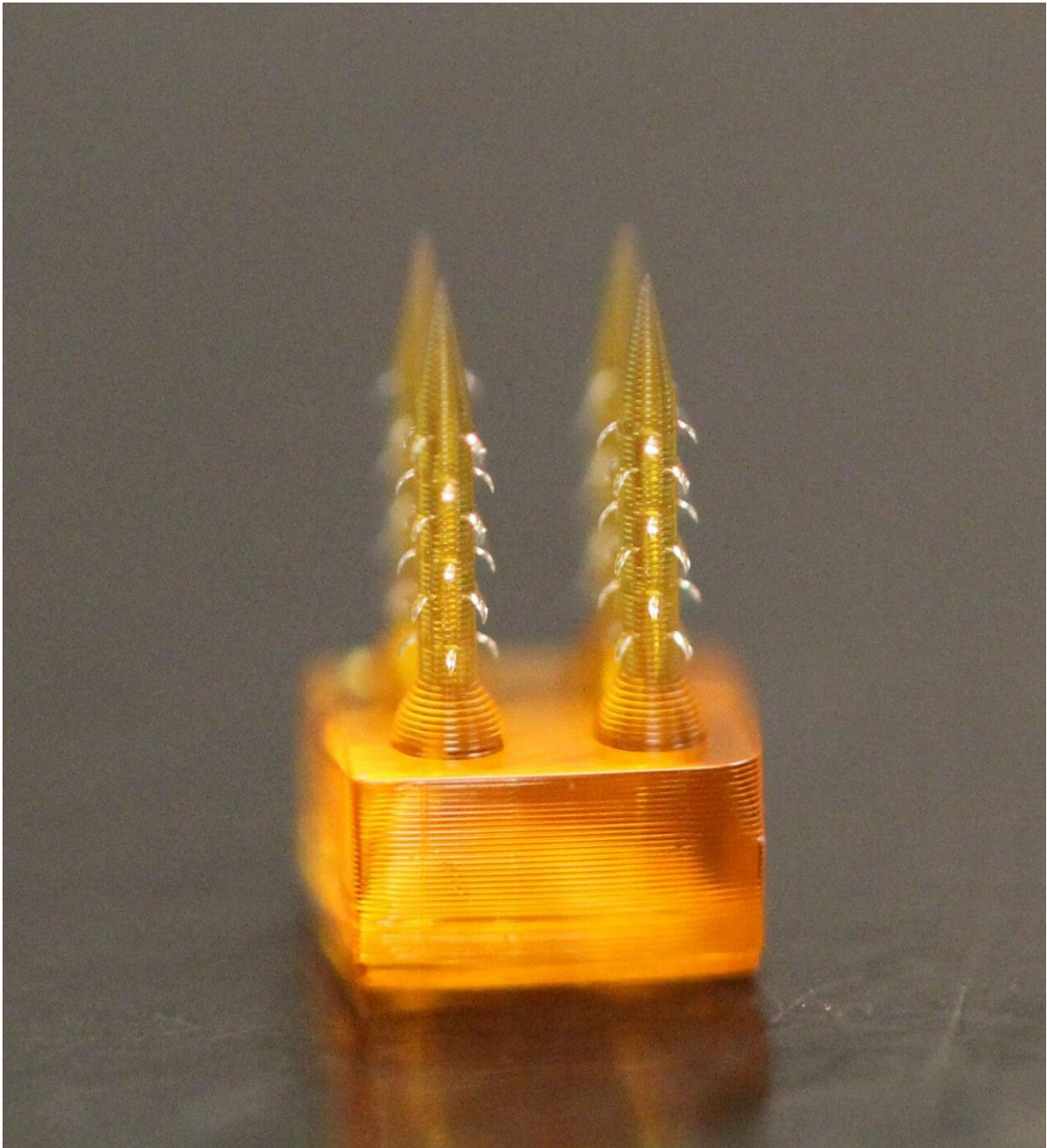


High-tech printing may help eliminate painful shots

February 4 2020



Microneedle array has backward-facing barbs that interlock with tissue when inserted, enhancing adhesion. Credit: Riddish Morde

Painful hypodermic needles may not be needed in the future to give

shots, inject drugs and get blood samples.

With 4-D printing, Rutgers engineers have created tiny needles that mimic parasites that attach to tissues and could replace [hypodermic needles](#), according to a study in the journal *Advanced Functional Materials*.

While 3-D printing builds objects layer by layer, 4-D goes further with smart materials that are programmed to change shape after printing. Time is the fourth dimension that allows materials to morph into new shapes.

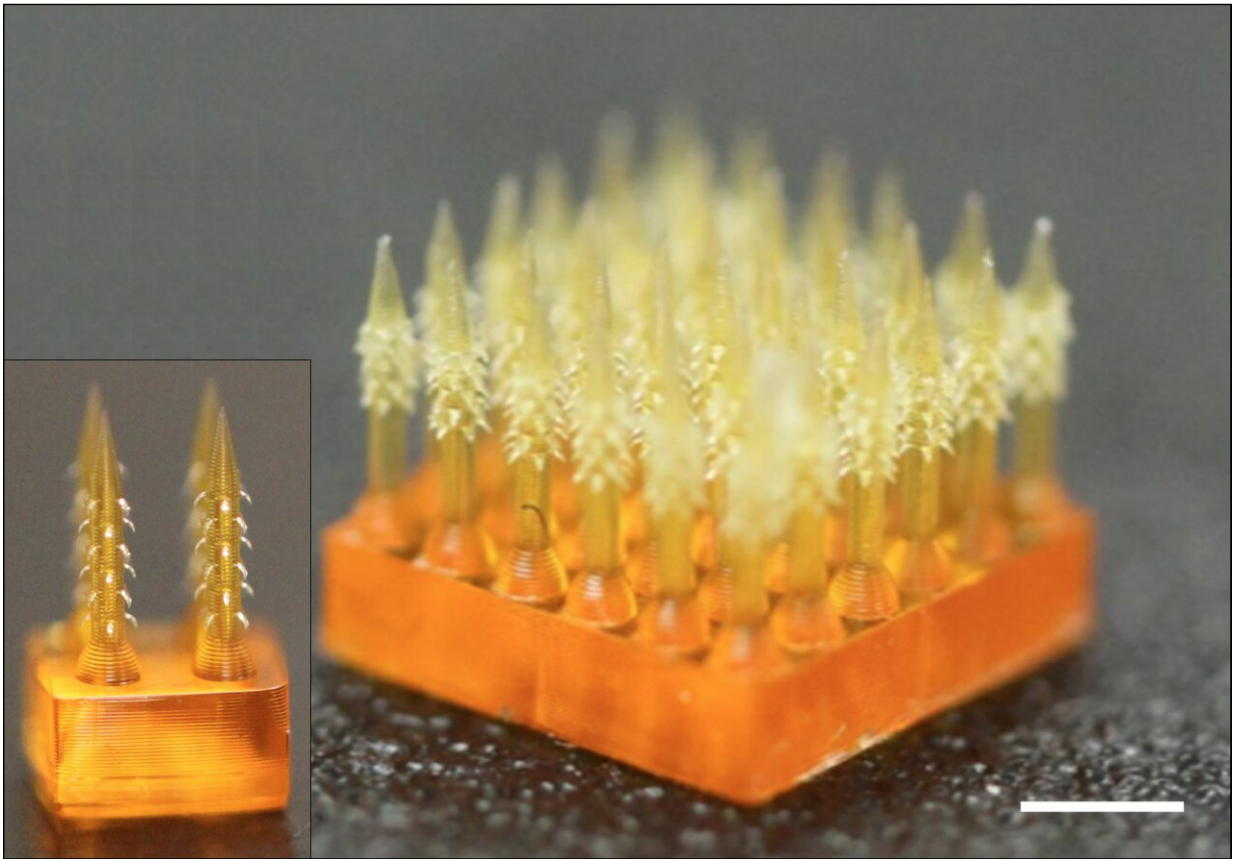
"We think our 4-D-printed [microneedle](#) array will allow for more robust and sustained use of minimally invasive, pain-free and easy-to-use microneedles for delivering drugs, healing wounds, biosensing and other soft [tissue](#) applications," said senior author Howon Lee, an assistant professor in the Department of Mechanical and Aerospace Engineering in the School of Engineering at Rutgers University-New Brunswick.

Hypodermic needles are widely used in hospitals and labs to extract blood and inject drugs, causing pain, scarring skin and posing an infection risk. People with diabetes often take [blood samples](#) multiple times a day with needles to monitor blood sugar levels.

Microneedles (miniaturized needles) are gaining attention because they are short, thin and minimally invasive, reduce pain and the risk of infection and are easy-to-use. But their weak adhesion to tissues is a major challenge for controlled [drug delivery](#) over the long run or for biosensing, which involves using a device to detect DNA, enzymes, antibodies and other health indicators.

In nature, some insects and other organisms have developed microscopic features that adhere to tissue, such as the microhooks of parasites,

barbed stingers of honeybees and scaled quills of porcupines. Inspired by these examples, Rutgers engineers developed a microneedle that interlocks with tissue when inserted, enhancing adhesion. They combined a micro 3-D-printing technique and a 4-D-printing approach to create backward-facing barbs on a microneedle.



This microneedle array has backward-facing barbs that interlock with tissue when inserted, enhancing adhesion. Credit: Riddish Morde

Using chicken muscle tissue as a model, the researchers showed that tissue adhesion with their microneedle is 18 times stronger than with a barbless microneedle. Their creation outperforms previously reported

examples, resulting in more stable and robust drug delivery, collection of bio-fluids and biosensing, the study says.

More information: Daehoon Han et al, 4D Printing of a Bioinspired Microneedle Array with Backward-Facing Barbs for Enhanced Tissue Adhesion, *Advanced Functional Materials* (2020). [DOI: 10.1002/adfm.201909197](https://doi.org/10.1002/adfm.201909197)

Provided by Rutgers University

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