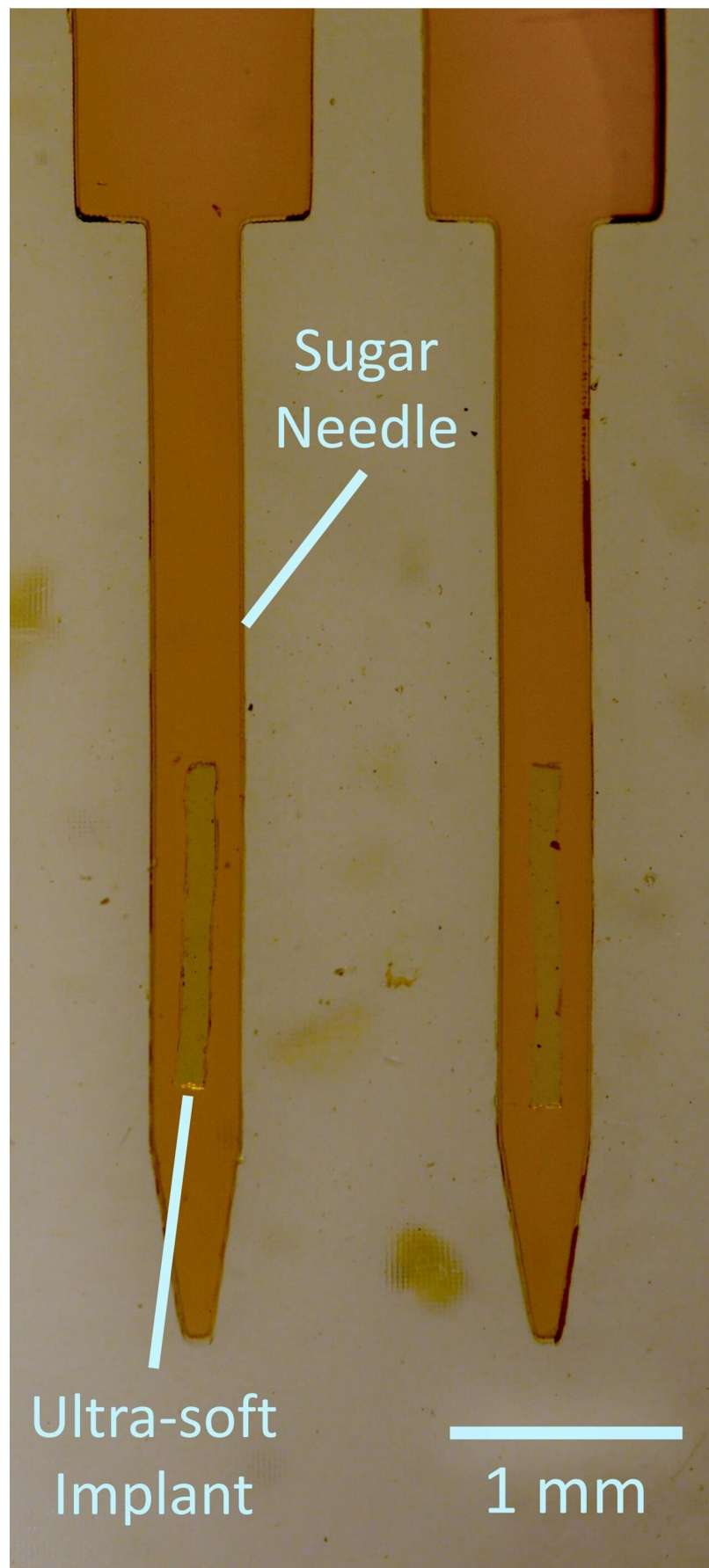


Study uses sugar to make and deliver pudding-like brain implants that reduce foreign body response

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When surgically inserted into the brain, the sugar needle carried the implant to the right location, and dissolved within seconds, leaving the delicate implant in place. Credit: Edward Zhang

Brain implants are used to treat neurological dysfunction, and their use for enhancing cognitive abilities is a promising field of research. Implants can be used to monitor brain activity or stimulate parts of the brain using electrical pulses. In epilepsy, for example, brain implants can determine where in the brain seizures are happening.

Over time, implants trigger a foreign body response, creating inflammation and [scar tissue](#) around the [implant](#) that reduces their effectiveness.

The problem is that traditional implants are much more rigid than [brain tissue](#), which has a softness comparable to pudding. Stress between the implant and the [tissue](#) caused by constant movement of the brain with respect to the implant signals the body to treat the implant as a foreign object. This interaction between the implant and the brain is similar to a knife cutting into a piece of pudding. An implant as soft as brain tissue would be ideal, but such soft implants would be difficult to manufacture and implant on the microscale.

A team of researchers from The Neuro (Montreal Neurological Institute-Hospital) and McGill's Department of Biomedical Engineering found a solution using silicone and sugar.

By using silicone polymers, widely known for their [medical applications](#), the scientists were able to make the softest brain implant to date with the

thickness of a thin sewing thread (~0.2 mm), and the consistency of soft pudding—as soft as the brain itself. They were then able to implant it into the brain using a trick from the cookbook.

They adopted classical cooking techniques of sugar melting, caramelizing and molding both for making the implant, as well as for encapsulating it into a needle made of hardened sugar.

When surgically inserted into the brain of an anesthetized rat, the sugar needle carried the implant to the right location, and dissolved within seconds, leaving the delicate implant in place. Sugar is non-toxic and is naturally metabolized by the brain. Examining brain tissue three and nine weeks after implantation, the team found higher neuronal density and lower foreign body response compared to traditional implants.

While more research is needed to develop electrically active, soft implants, and to prove the safety and effectiveness of the technique in humans, one day it could be used to unlock the potential of brain implants in treating neurological disease and dysfunction.

"The implants we created are so soft that the body doesn't see it as a big threat, allowing them to interact with the brain with less interference," says Edward Zhang, the study's first author. "I am excited about the future of brain implant technology and believe our work helps pave the path for a new generation of soft implants that could make brain implants a more viable medical treatment."

"By reducing the brains inflammatory response, our new, very soft implants are a good thing for the brain and a good thing for the long-term function of an implant," says Tim Kennedy, a researcher at The Neuro and the study's co-senior author. "The miniature sugar needle devised by Zhang is a sweet solution to placing the super-soft implant into equally soft brain tissue."

"Biomedical engineering research is about making the impossible, possible," says David Juncker, a professor of [biomedical engineering](#) at McGill and the study's co-senior author. "Here we set out to make an implant as soft as the brain and implant it into the [brain](#), which was a major challenge. We are excited about the results, and the possibility it opens up for long lasting, well-tolerated [brain implants](#)"

More information: Edward N. Zhang et al, Mechanically Matched Silicone Brain Implants Reduce Brain Foreign Body Response, *Advanced Materials Technologies* (2021). [DOI: 10.1002/admt.202000909](#)

Provided by McGill University

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