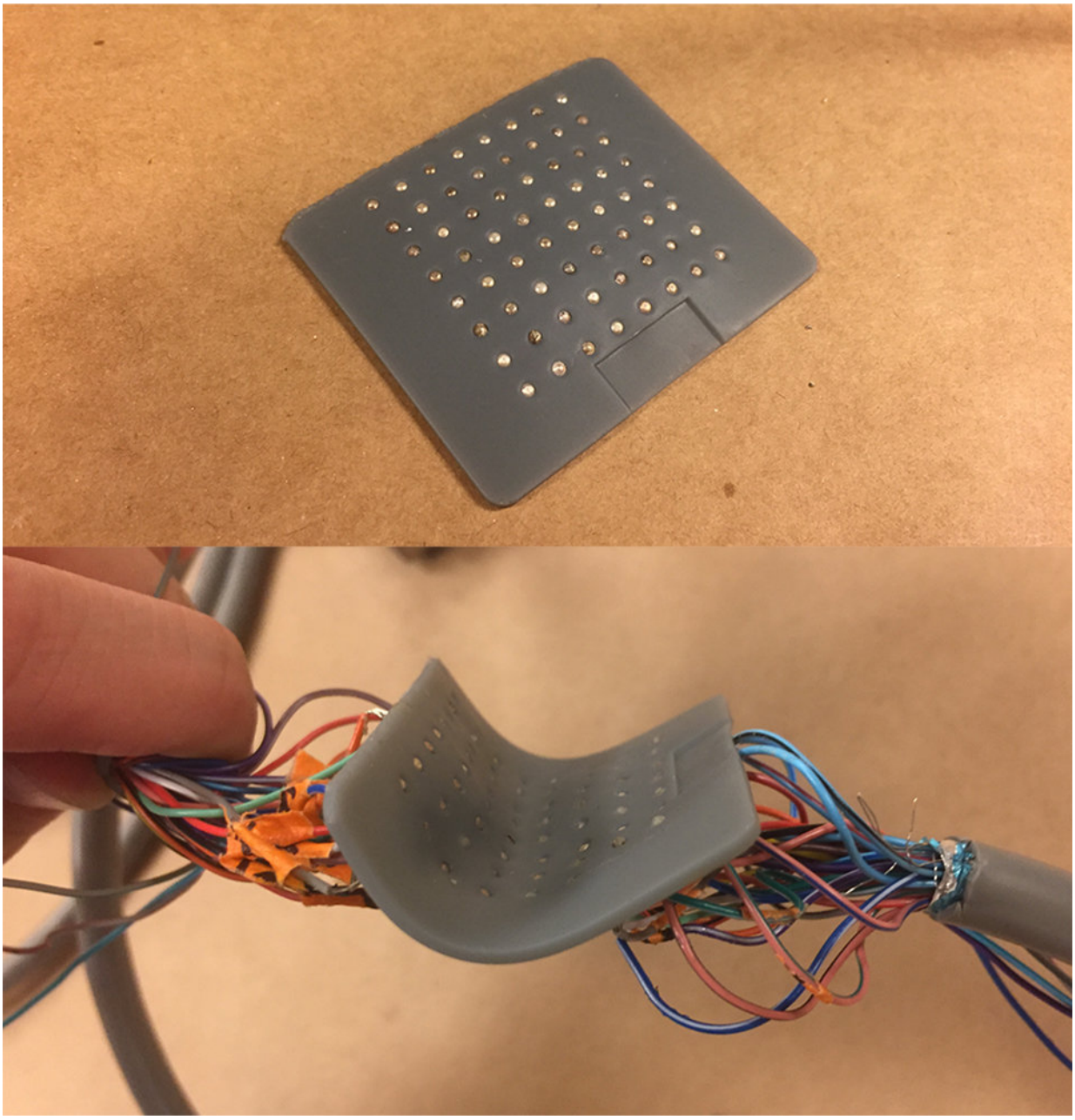
Researchers using 3-D printing to build custom cardiac surgical devices

July 27 2018, by Alex Kekauoha



Credit: Stanford University

Second-year medical student Kevin Cyr is part of a team of Stanford researchers investigating new ways to survey electricity in the heart. The research has led to the development of cardiac surgical devices that could one day help patients who suffer from a common heart ailment.

"I'm using 3-D-printed tools to design cardiac-mapping catheters, devices used by surgeons to map the electrical activity of the heart and find disturbances," says Cyr.

The research began a few years ago under the direction of Anson Lee, assistant professor of cardiothoracic surgery. Cyr, whose background is in bioengineering, joined the team last year as a student interested in developing new medical technologies that can transition from research to clinical practice.

Their investigation is focused on atrial fibrillation, or AFib, a heart disorder characterized by irregular and often rapid heartbeats that disrupt the flow of blood from the heart to the rest of the body. It is the most common rhythm disorder, which affects more than 6 million Americans and is responsible for over 750,000 hospitalizations every year. While some AFib patients have few, if any, problems, others suffer serious complications requiring surgery or medications.

Cyr says that finding and understanding rhythm disturbances in patients has been challenging because of the one-size-fits-all nature of existing medical devices, which use electrodes that contact the surface of the heart to measure electrical activity. So the researchers created devices that are customized to each patient, conforming to the unique contours

and divots of the individual's heart.

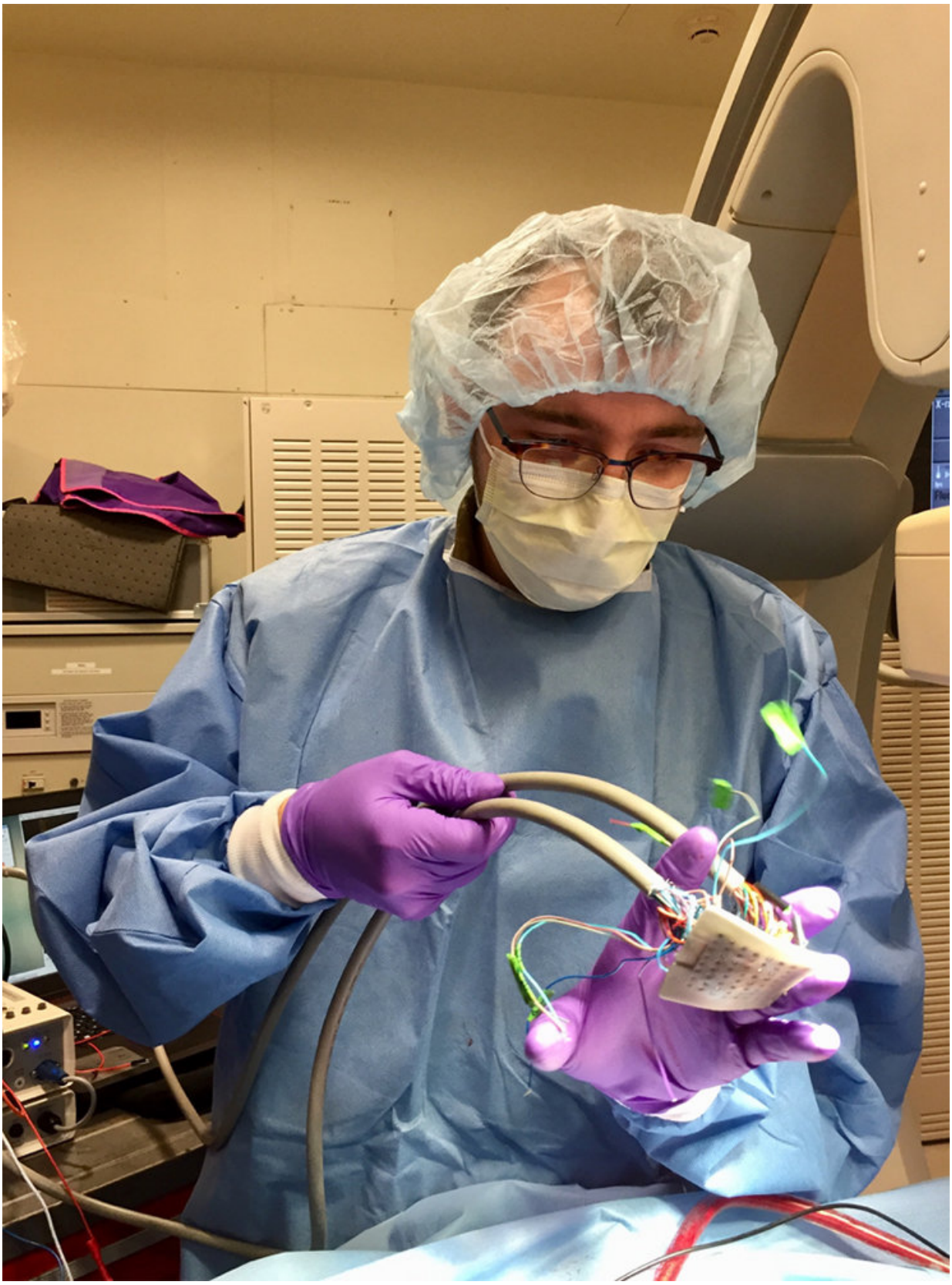
Credit: Stanford University

To do this, patients undergo an MRI or CT scan that records an image file of their heart, which is then fed into a 3-D printer. Cyr says that using the scan, "we can replicate that natural geometry and anatomy specific to that patient" and apply it to the device.

The device is a small, thin, flexible silicone membrane with tiny holes in a grid-like formation, each holding a tiny electrode. When placed on the

surface of the heart's atrium, the device can measure the electrical activity over that specific region of the heart. The data is transmitted to a computer, where it produces a recording that shows the electrical activity at that site. The recordings produce a heatmap of the electrical activity that physicians use to identify the regions of the heart that need treatment.

The customized device can track electrical activity with great precision, Cyr says. "We can map in perfect detail this rectangular grid of information and not have to worry about missing signals, poor contact or things like that, which otherwise might throw out errors."



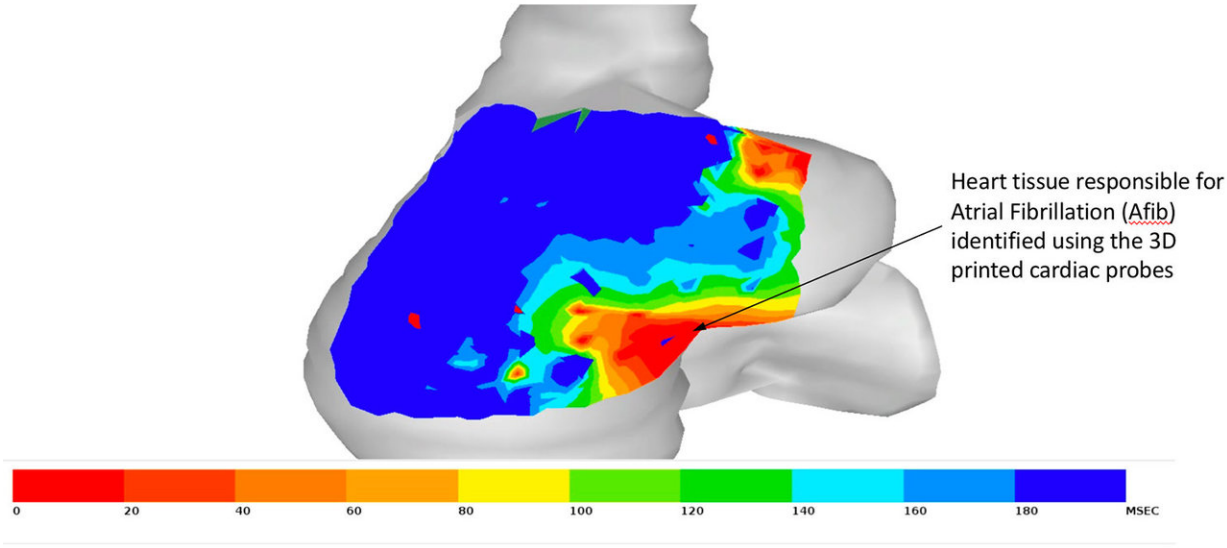
Credit: Stanford University

The devices are currently used on the epicardium, or exterior, layer of the heart.

The researchers are investigating whether their 3-D-printed device could also be used to map the interior surface of the heart. If so, they believe it could provide much greater accuracy in measuring the rhythmic disturbance there as well.

The underlying goal of the research is to identify the problem spots where irregular electrical activity occurs and remove them to restore normal electrical flows.

Cyr says the researchers will likely take another year or two to refine their technology, which has not yet been tested on humans.



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