The Next Big Thing You Missed: 3-D Printing Promises Better Bionic Limbs for the War-Wounded

David Sengeh is developing 3-D printed artificial limbs at the MIT Media Lab. *Photo: Allegra Boverman/TED*

David Sengeh grew up in Sierra Leone during the African country's decade-long civil war. The horribly bloody conflict was defined not just by the enormous death toll, but by the way rebel armies systematically severed the limbs of their enemies, leaving thousands of men, women, and children with missing arms and legs. Though the war ended more than a decade ago, Sengeh says, many victims are still struggling through life with artificial limbs that are too uncomfortable to wear.

But at the famed MIT Media Lab, the 27-year-old doctoral student is now using 3-D printing and advanced math to create a new kind of artificial limb he believes can significantly improve the lives of amputees in Sierra Leone and across the rest of the world. Sengeh relies on data-backed digital models to fashion prosthetics that he says better match the contours of the human body. And because these prosthetics are fabricated by 3-D printers, he says, they become far easier to produce.

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don't fit. Many people who have lost limbs — whether they're Sierra Leone civilians or U.S. war vets — don't wear their prostheses because the sockets aren't tailored to their bodies. The tools needed to make well-fitting artificial limbs today are neither affordable nor widespread. "It does not matter how powerful your prosthetic ankle is," Senghe said on Monday during a talk at TED, the global ideas conference being held this year in Vancouver, British Columbia. "If your prosthetic socket is uncomfortable, you will not use your leg."

According to Senghe, in Sierra Leone, most of the prosthetic sockets are made using traditional molding and casting methods. The imprecision, he says, can leave wearers suffering from pressure sores and blisters that make their artificial limbs unusable. So he decided to focus his Ph.D. research on custom prosthetic sockets that could be made quickly and cheaply.

His method begins with an MRI (magnetic resonance imaging) scan that captures a three-dimensional picture of the remains of a person's limb. Then, borrowing a technique that has been a part of aerospace, defense, and automotive industries for decades, he transforms the MRI scan into a mathematical model for a prosthesis that identifies specific points of stress. This model is then fed into a 3-D printer that fabricates the custom sockets. "It's so soft, it's like walking on pillows," one U.S. vet told Sengeh after trying on his prosthesis.

But the Sengeh's project doesn't just improve the comfort of artificial limbs. It also lets non-experts manufacturer them. As 3-D printing becomes an increasingly commoditized technology, fashioning these sophisticated devices could be as easy as feeding a limb scan into a piece of software, which could potentially happen anywhere. Sengeh says experts in prosthesis-making are scarce, and not just in Sierra Leone. By developing a software-based approach to better limb-making, he hopes that he has found a way to package this expertise and distribute it worldwide.

Some hurdles remain. A key to the design, he says, is that the socket be both flexible and stiff in the right places to make it as usable as the lost limb itself. One version of the design relies on a carbon fiber frame that can't yet be fabricated by a 3-D printer, though he believes this will soon change.

Let's hope it will. Scalable sockets, Sengeh says, mean not just comfort but more meaningful lives for wearers. "For me," Sengeh told his TED audience, "a place to begin healing the souls of those affected by war and disease is by creating comfortable and affordable interfaces for their bodies."