A smart shoe to help reduce diabetic amputations

March 2 2016, by Sarah Perrin

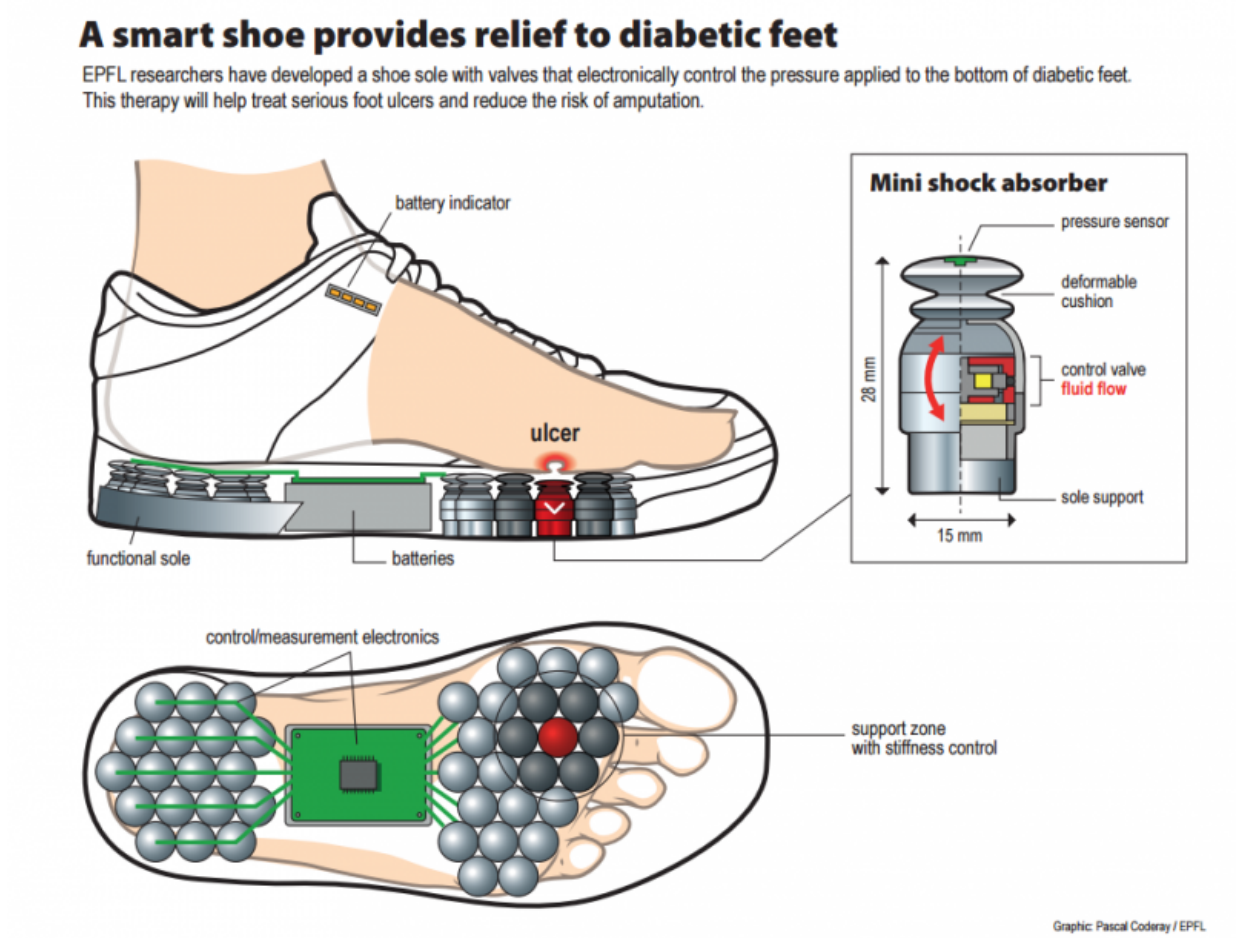
Credit: EPFL

EPFL researchers have developed a shoe sole with valves that electronically control the pressure applied to the arch of the foot. The goal is to relieve foot ulcers commonly caused by diabetes and help them heal to avoid dangerous secondary infections.

Diabetes can lead to dangerous complications that all too often end in

amputation of the foot or even death. To avoid these eventualities, a team of researchers from EPFL is collaborating with the Geneva University Hospitals (HUG) on a smart shoe. The technology is based on actuators that electronically control the stiffness of the sole in order to reduce the onset of diabetic foot ulcers and prevent existing ones from worsening. An initial prototype has just been completed.

Every year in Europe, 250,000 diabetics have a leg amputated, and the mortality rate is 30% at 30 days and 50% at one year. Foot ulcers are the root cause of most of the amputations. These wounds, which are the result of vascularization and excess pressure, easily worsen in part because they are not painful. Many diabetics are unaware of how serious they are and continue to walk normally, preventing the ulcers from healing. They don't see their doctor until the lesion reaches the bone, at which point the risk of secondary infection and then gangrene is high.



Controlling viscosity

The challenge for doctors is threefold. They need to find a way to remove all pressure from the ulcers as soon as they appear, keep it off as long as necessary for them to fully heal, and quickly react to new ulcers, which can reappear at any time elsewhere on the arch of the foot.

In response to this challenge, researchers from EPFL's Integrated Actuators Laboratory (LAI) in Neuchâtel came up with an idea: embed

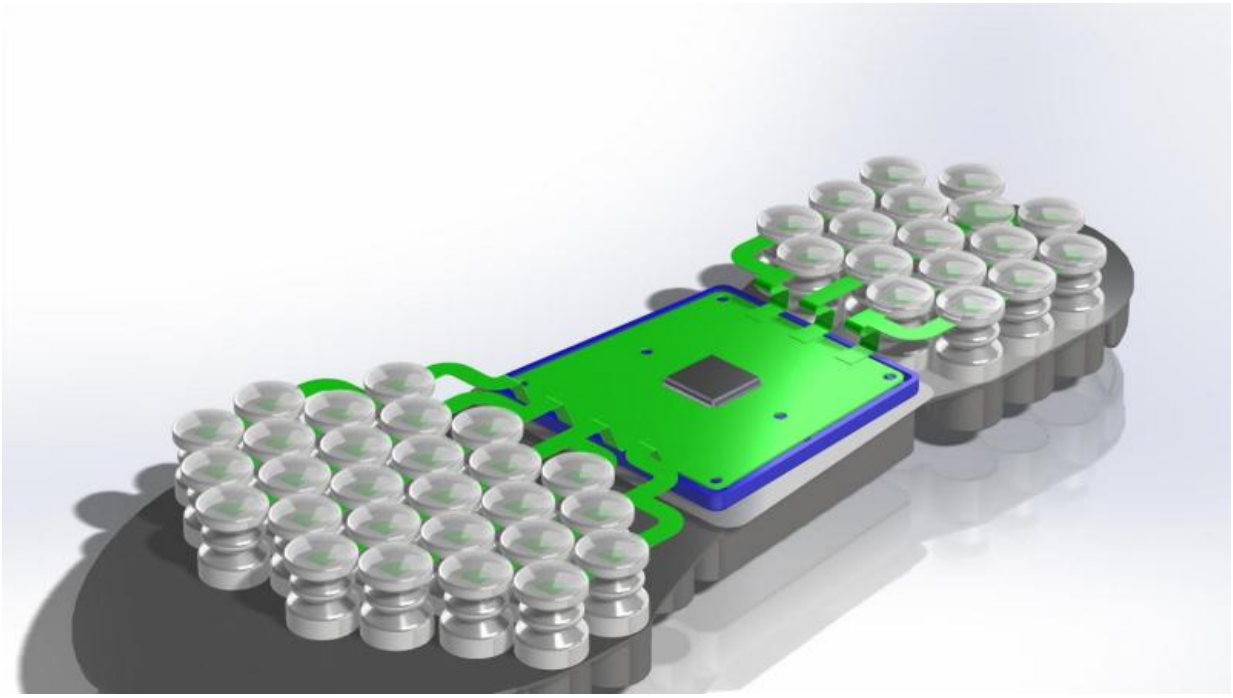
the sole of a shoe with around 50 small electromagnetic valves filled with magnetorheological material. "We can control the viscosity of the material, which is made up of suspended iron microparticles," said Yves Perriard, the director of LAI. "When we apply a magnetic field, the particles react immediately and align themselves with it, causing the material to change from liquid to solid state in a fraction of a second."

This means that the rigidity in different parts of the shoe sole can be controlled separately depending on where the sensitive areas and wounds are. The system should not only help the wounds heal quickly but also prevent the onset of new ulcers.

Credit: EPFL/A.Herzog

Fewer constraints

This invention offers a number of advantages, such as considerably simplifying diabetics' day-to-day life. "A number of other solutions exist, such as bandages and pressure-relief insoles," said Zoltan Pataky, an internal medicine specialist at HUG who started the project. "But they are very restrictive and need to be constantly adjusted, and so patients are often reluctant to use them and doctors hesitate to prescribe them. The advantage of this shoe is that, in addition to relieving the arch of the foot wherever necessary, it immediately adjusts the pressure as some ulcers heal and others appear." The lab is currently searching for industry partners to further develop the project.



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