AI-based prosthetic socket developed to help thigh amputees
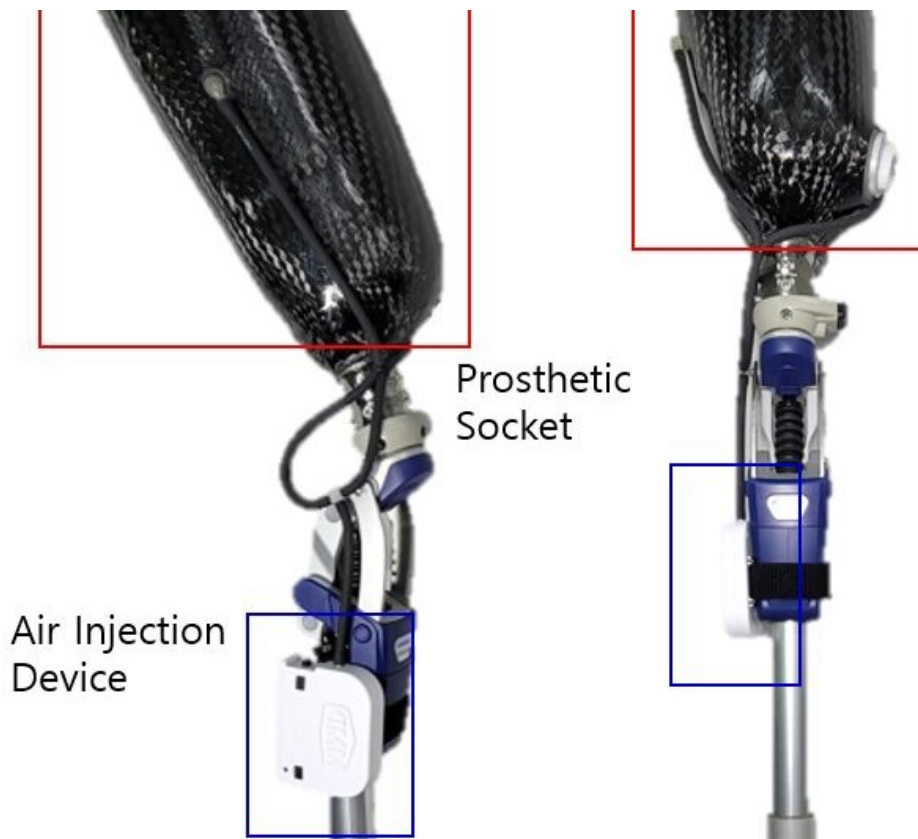
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Smart, Customizable Prothetic Socket—Knee Joint Type. Credit: Korea Institute of Machinery and Materials (KIMM)

The Korea Institute of Machinery and Materials (KIMM), an institution under the jurisdiction of the Ministry of Science and ICT, has succeeded

in developing a smart, customizable prosthetic socket that automatically fills the socket with air upon detecting the empty space inside in real time based on artificial intelligence.

This new technology developed by senior researcher Kang-ho Lee's research team at the KIMM Department of Medical Devices can respond to up to 15% of changes in the volume of the amputated area, which changes frequently depending on blood circulation, skin tissue condition, and nutritional status of the patient. Accordingly, the prosthetic socket relieves pain in the affected area by distributing the applied pressure while minimizing the socket's movement.

The research team made it possible to analyze the gait stability of the prosthetics user by linking the socket with a smartphone app, so that the patient can monitor the pressure inside the prosthetic socket in real time. In addition, the user can directly control the injection and discharge of air in the socket by setting the prosthetic to either automatic or manual mode.

Prosthetic limbs, such as prosthetic legs and prosthetic arms, are manufactured with sockets that fit the size of the residual limb. When wearing a socket that does not match the volume of the affected area, movement, pressure, and friction of the affected area may cause walking fatigue and lead to skin disease at the site of amputation.

There are some products developed overseas that allow the user to adjust the socket size through a dial, but the disadvantage of such technology is that it is difficult to respond to the volume change of the affected area in real time, requiring manual adjustment as needed.

KIMM's newly developed smart, customizable prosthetic socket continuously measures the wearer's gait stability based on AI. As such, it greatly reduces any stress on the amputation site by controlling the

volume of the prosthetic socket and modifying it in real time according to changes in the walking environment such as flat ground, stairs, or inclines, and changes in walking speed.

Prosthetic Socket

Air Injection Device

Smart, Customizable Prothetic Socket—Socket Attachment Type. Credit: Korea Institute of Machinery and Materials (KIMM)

Senior researcher Lee Kang-ho stated that the smart, customizable prosthetic socket reduces any fatigue the wearer might experience while walking, while also alleviating pain in the affected area.

Furthermore, users can monitor the pressure distribution in the socket in real time through a smartphone app, which can contribute to improving their gait. He also added that, through the commercialization follow-up study, the KIMM research team hopes to contribute to improving the quality of life of prosthetic wearers and help improve domestic technologies for rehabilitation medical devices."

Before (right) and after (left) air injection into the socket. Credit: Korea Institute of Machinery and Materials (KIMM)

This research study was carried out as part of the "Development of human enhancement medicine technologies for rehabilitation of lower and upper extremity motor functions" project from a basic research program being conducted by KIMM.