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3D-printed X-Brace gives relief to knees

16th December 2021 11:12 am

People with knee problems will soon have access to X-Brace, a 3D-printed orthopaedic brace developed in a collaboration between engineering company Delsson and Nanyang Technological University, Singapore (NTU Singapore).



(Right) Centre for Orthopaedics chairman & CEO Dr Jeffery Chew helping Mdm Teo Lee Lee (left), his patient who had two knee replacements, to wear the X-Brace (Image: NTU Singapore)

Using 3D printing techniques the team has reduced the weight of a traditional exoskeleton knee brace, typically built with metal, by 30 per cent, thanks to a new design that uses lightweight plastic and assistive springs.

Braces are usually prescribed to the elderly patients to help alleviate the burden on their knee joints, as well as to assist patients who have undergone knee surgery.

X-Brace is based on the prototype assistive orthopaedic brace 3D-printed by NTU researchers and developed by Singapore-headquartered Delsson and the Centre for

Orthopaedics in Singapore. The result is a knee brace that weighs about 720g and is 30 per cent lighter than metal orthopaedic braces.

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The prototyping process and product design iterations using additive manufacturing were conducted at [NTU's Singapore Centre for 3D Printing](#).

NTU assistant professor Chan Wai Lee, the principal investigator of this project from the School of Mechanical and Aerospace Engineering, said 3D-modelling was heavily used to validate the various design ideas that led to the weight reduction.

Joel Lim, an NTU PhD student in Asst Prof Chan's team, led the design efforts in collaboration with Delsson and 3D-printed the prototype for real-life validation tests.

"Lightweight and strength are crucial to this project. We first analysed the conventional knee braces and their current bill of material. We decided to change to a plastic material with optimised structure. Using topology optimisation with a delineated stress map and 3D modelling, we then designed new structures and joints that are strong enough to withstand the flex of the knee and still assist it to move in the correct direction," Lim said in a statement.

Fabian Ong, executive director of Delsson Singapore, said the X-Brace will change the way doctors and physiotherapists treat and manage different knee conditions because the amount of assistance given by the brace can be customised from 6kg to 32kg of force.

"X-Brace will be revolutionary for patient recovery. It is light weight and does not slip, while its modular assistance load allows patient recovery to be individualised. NTU's help in providing a quantitative methodology to reduce wall thickness and profile of the frame was crucial in achieving the weight reduction after several reiterations," Ong said.

The joint team worked to improve version 7 of the X-Brace, which consists of a light-weight Nylon 6 frame designed to support bending forces of up to 50kg about the axis of the knee. The product development is now in its 9th version.

The X-Brace is expected to be available in the market at a price of US\$782 depending on the user's required configuration.

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