

Plastic Knee Brace May Revolutionize Patient Recovery



3D modeling was crucial in validating design ideas that led to a 30% weight reduction compared with conventional knee braces.

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An engineering firm in Singapore has developed a knee brace that is 30% lighter than conventional metal versions without a loss in robustness thanks to a design that uses plastic and assistive springs. The X-Brace was placed on the market this month.

Based on a prototype assistive orthopedic brace 3D-printed by scientists at Nanyang Technological University, Singapore (NTU Singapore), the X-Brace resembles the knee brace used by Batman in *The Dark Knight Rises*. It was developed by engineering firm Delsson and Singapore's Centre for Orthopaedics.

An estimated one-third of the US population has reported suffering from knee pain at some point.

The knee brace will benefit elderly patients who often need help to alleviate the burden on their joints, helping them to climb stairs, for example. It can also benefit patients who have undergone knee replacement surgery or reconstruction of torn ligaments in their rehabilitation and recovery.

“Light weight and strength are crucial to this project,” said Joel Lim, an NTU PhD student who led design efforts in discussion with Delsson and 3D-printed the prototype for real-life validation tests. “We first analyzed the conventional knee braces and their current bill of material. We decided to change to a plastic material with optimized structure. Using topology optimization with a delineated stress map and 3D modeling, 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,” explained Lim.

The X-Brace is set to change the way doctors and physiotherapists treat and manage different knee conditions, according to Delsson, because the amount of assistance provided by the brace can be customized from 6 to 32 kg of force.

“X-Brace will be revolutionary for patient recovery,” said Fabian Ong, Executive Director, Delsson. “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.”

The joint team worked to improve version 7 of the X-Brace, which consists of a lightweight nylon 6 frame designed to support up to 50 kg of bending forces. A ninth version of the X-Brace now in development is designed to be even slimmer than the current model.

The X-Brace is distributed by Wearable Kinetics, a subsidiary of Delsson, and has a list price of approximately \$780. The Centre for Orthopaedics in Singapore currently is the only medical clinic trained to prescribe use of the product.

