

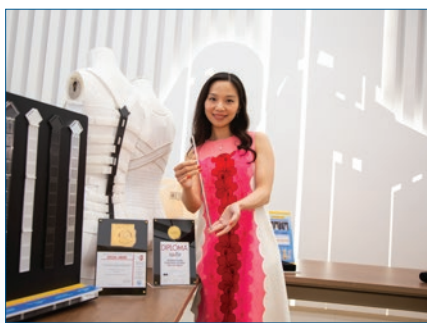
Technology Frontier

News Bite on PolyU's Innovation



Flexible Scoliotic Brace with Shape Memory Alloy Light, comfortable, as effective as a hard brace

Scoliosis affects many adolescents, and it may cause pain and other health problems as it progresses. Those with moderate curvature (25 - 40 degrees) are advised to wear a plastic hard brace, which is somewhat effective yet uncomfortable to wear and awkward to look at. Researchers from the Institute of Textiles and Clothing then came up with a flexible brace for scoliosis patients with moderate curvature that includes shape memory alloy struts and artificial hinges. It is aimed at being as effective as a hard brace, but less conspicuous and lighter in weight, offering more comfort and flexibility.



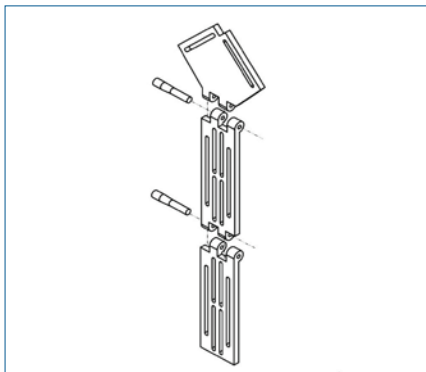
Dr Joanne Yiu-wan Yip, Associate Professor



Flexible Scoliotic Brace with Shape Memory Alloy

Scoliosis is one of the most common back deformities suffered by as many as 4% of teens and preteens. Patients typically show an S- or C-shaped backbone that bends or twists three-dimensionally. The curvature may worsen among developing young patients and may cause back pain or other health problems in severe cases. So far, surgery is recommended to those with extreme deformity (i.e. curvature exceeding 40 degrees). Those with moderate deformity (i.e. curvature between 25 and 40 degrees) are told to wear a hard brace made of rigid plastic to slow down the progression. Patients with mild deformity (i.e. curvature between 6 and 25 degrees) are only put under observation without treatment. In

2015, Dr Joanne Yiu-wan Yip, Associate Professor, Institute of Textiles and Clothing, and her research team designed an award-winning posture-corrective girdle for scoliosis patients with mild deformity. This year, they made an interdisciplinary effort to upgrade the posture correction girdle by replacing the plastic boning in the original design with an advanced material known as shape memory alloy (SMA). Better still, the team came up with a flexible brace for scoliosis patients with moderate curvature, leveraging the same advanced material and artificial hinges inspired by metal watch bands. The new flexible scoliotic brace has proven to be as effective as a hard brace, while offering much better wearing comfort without



Artificial hinge design



The Flexible Scoliotic Brace with Shape Memory Alloy won a gold medal and a special merit award in the Silicon Valley International Invention Festival 2019.

showing under school uniforms and other garments.

Shape memory alloy (SMA)

The concept of the team's posture corrective girdle in 2015 was a form-fitting, breathable and flexible garment made with elastic straps that can be adjusted according to the patient's spinal curvature. Plastic boning and semi-rigid pads are inserted to apply corrective forces. "We kept on trying out different materials and fine-tuning its details and design. Experiments showed that shape memory alloy (SMA) strikes the best balance between stiffness and recovery," explained Dr Yip. A scoliotic brace works by counteracting with the curvature to stop the spinal curve from worsening. There must be stiff components in the brace to provide that force. However, a patient has to move her body in the brace and may deform those components after prolonged and repeated wearing. Therefore the best material for those components should not only be stiff, but also shape-recoverable. "SMA is a material that has shape-memory and is super-elastic. Even if it deforms, it can restore its shape under a certain temperature, such as body temperature. Patients are also free to move in the brace as SMA is flexible, but also it is stiff enough to provide support at the same time," added Dr Yip.

Artificial hinges

The team's flexible scoliotic brace for patients with moderate curvature works in similar manner as the girdle,

also featuring adjustable elastic straps with semi-rigid pads and SMA strut inserts. But the design that separates it from the girdle is the artificial hinges along the spine. "We were thinking about a structure that would allow movement, say, bending over to pick up something from the floor, but is still stiff enough sideways to correct the spinal curve. We were inspired by metal watch band and we made the artificial hinges." These hinges allow the spine to bend forward and backward, but not rotate or bend across the sagittal plane. That ensures the corrective forces from the elastic straps, SMA struts and pads are constantly applied, while allowing some freedom of movement. By applying a three-point pressure system, the corrective angle and forces can be highly customized and precise. Of course, the flexible scoliotic brace is much lighter than the hard brace, offering more comfort and flexibility. It is also breathable and doesn't show under garments, meaning patients are more likely to wear it according to the instruction.

In the clinical trial, subjects show an average curvature correction of 5 degrees, while in some cases the correction could be as much as 20.4 degrees (around 89% improvement), similar to a hard brace.

In June 2019, Flexible Scoliotic Brace with Shape Memory Alloy won a gold medal and a special merit award in the Silicon Valley International Invention Festival.