

Technology Frontier

News Bite on PolyU's Innovation

Biofeedback Tank-Top

Training muscle balance and correcting posture among early scoliotic youth

Teenagers with adolescent idiopathic scoliosis (AIS) typically show a C-shaped or S-shaped spine. While minor cases may not cause any health problem, care should be taken to prevent the progression of spinal curvature. Conventional non-invasive treatments include passive correction of the curvature with braces. Researchers from the Institute of Textiles and Clothing came up with a Biofeedback Tank-top that trains the balance of back muscles actively among patients. In the wear trial, most subjects were found to have either no curvature progression or an improved curvature after 30 tailor-made posture training sessions and daily home practice.



Dr Joanne Yiu-wan Yip (right) and her research team member

Scoliosis is the abnormal curvature of the spine that results in a C-shaped or S-shaped backbone. Adolescent idiopathic scoliosis (AIS) in particular refers to such spinal deformity among rapidly developing preteens and teens with no known cause. AIS affects 2 to 3% of the population aged between 10 and 16, and 9 out of 10 patients are female. Surgical operation is recommended in severe cases and those with moderate curvature are prescribed to wear hard braces. As opposed to passive correction of spinal curvature with braces, Dr Joanne Yiu-wan Yip, Assistant Professor, Institute of Textiles and Clothing, led a research team to develop a device tank-top with a biofeedback system that helps early

AIS patients build muscle memory actively. In the wear trial, all subjects were found to exhibit more balanced muscle profiles after repeated training and most observed either no curvature progression or a reduced curvature.

Building muscle memory

"Though there aren't well-accepted causes for AIS, poor posture could be a possible factor that results in back pain, stress and further deformity among patients. The biofeedback tank-top aims at building good posture habits by training the back muscles of the patients," said Dr Yip. When a subject naturally balances the forces exerted by her back muscles after repeated training, she also learns to



The body mapping tank-top with good wearing comfort



Biofeedback system design



The biofeedback tank-top for adolescents with early scoliosis won a special gold medal and a special merit award in the 45th International Exhibition of Inventions of Geneva.

maintain proper posture at ease and her scoliosis may be less likely to worsen.

The biofeedback tank-top is made up of three parts: the sensors, the garment and the app called Prain. Three sensors are inserted into the pouches on the garment along the spine. Each Bluetooth-enabled sensor carries a 3-axis accelerometer and a gyroscope to measure the body angle of the subject. Subjects are told to put on the tank-top for 30 minutes every day. When connected to a smartphone, the sensor readings are compared to a suggested profile pre-set by the therapist. If proper posture is not maintained, the user will be prompted. The data will be uploaded to a cloud server so that therapists can review the compliance rate and monitor a patient's progress from afar.

Clinical posture training

Besides practising at home, subjects were asked to attend 30 sessions of tailor-made posture training in three months. The patient sat in front of a monitor that played an animation video only when her left and right back muscles achieved a certain level of balance. The standard was set rather loosely at first, but the therapist would raise the bar little by little every session. "In our trial, all subjects showed improved muscle balance after 30 training sessions and this effect was found to last

among most subjects until the twelfth month since training started. In terms of spinal curvature, 90% and 80% of the subjects showed either no curvature progression or a reduced curvature by Month 6 and Month 12 respectively," said Dr Yip.

Wearing comfort and compliance rate

Apart from the core mechanism, much thought was put into making the tank-top a comfortable and aesthetically pleasing garment that subjects won't feel embarrassed or uncomfortable to put on. Dr Yip explained, "We care especially about compliance rate because even the best technology means little if the subjects never use it according to the instruction. The tank-top features minimal fabric coverage on the back to ensure coolness and wearing comfort. Foam cup lining can be inserted into the pouches in the front for breast support. A number of fibre mixes were tested for the best breathability, support and durability. We are glad that the compliance rate was extremely high in the wear trial."

In March 2017, the biofeedback tank-top for adolescents with early scoliosis won a Gold Medal with the Congratulations of Jury and a special merit award in the 45th International Exhibition of Inventions of Geneva, Switzerland.