First child exoskeleton for spinal muscular atrophy

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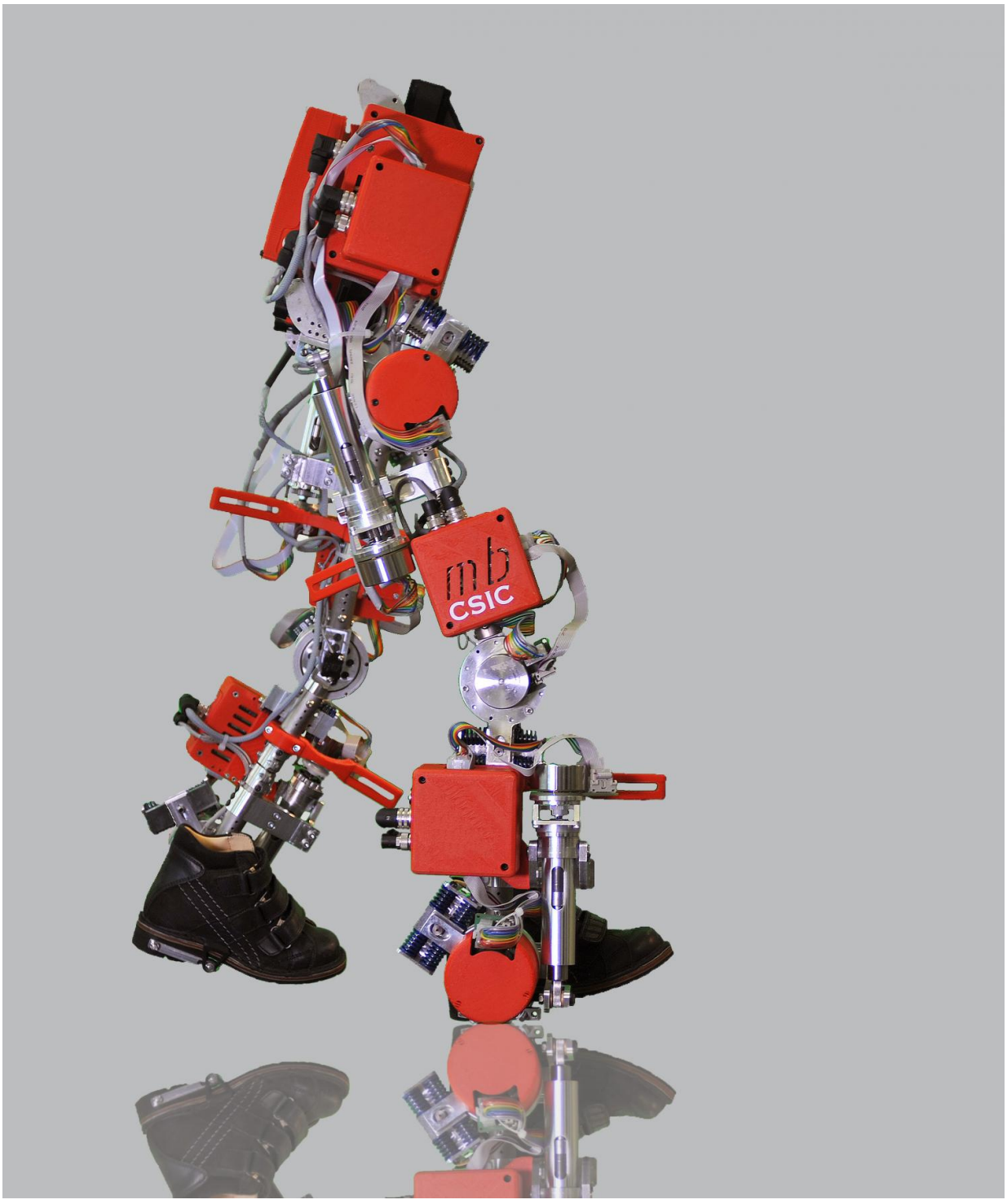

Exoskeleton designed by CSIC for children suffering from spinal muscular atrophy. Credit: CSIC

Researchers have introduced the world's first infant exoskeleton designed to help children with spinal muscular atrophy, a degenerative illness. Weighing 12 kilos, the apparatus is made of aluminium and titanium, and is designed to help patients walk—in some cases, for the first time.

It can also be used in hospital-based physiotherapy to prevent secondary effects associated with the loss of mobility associated with spinal muscular atrophy. The technology, which has been patented and licensed jointly by CSIC (the Spanish National Research Council) and its technology-based business unit, Marsi Bionics, is currently in the preclinical phase.

The brace consists of long support rods, or orthoses, which are adjusted to fit around the child's legs and torso. A series of motors in the joints mimic human muscles and give the child the necessary strength to stand upright and walk. Finally, a series of sensors, a movement controller, and a battery with five hours of life complete the system.

"The No. 1 drawback in developing this type of paediatric exoskeleton is that the symptoms of neuromuscular illnesses like spinal muscular atrophy change over time, as much in the articulations as in the body.That's why it's fundamental to have an exoskeleton capable of independently adapting to these changes. Our model includes intelligent joints that alter the brace's rigidity automatically and adapt to the symptoms of each individual child whenever required," explains Elena Garcia, from the Automatics and Robotics Centre, a CSIC/Politechnic Univerity of Madrid.

The exoskeleton is aimed at children between the ages of 3 and 14. With five motors in each leg (each requiring its own space to function), the minimum possible length of each leg is restricted. Furthermore, the unpredictability of the involuntary body movements of children under

three have forced researchers to set a lower age limit for the device. In other pathologies, which don't restrict any joint movement and so require fewer motors, it would be possible to build a smaller frame," adds García.

Five-year-old Álvaro, who suffers from spinal muscular atrophy, walks towards his parents during an exoskeleton test. Credit: Joan Costa - CSIC

A disease without a cure

Spinal muscular atrophy is one of the most serious degenerative neuromuscular diseases in children and, although it is rare, it results in high rates of mortality in affected babies and children. It is genetic and

causes progressive general muscular weakness. This loss of strength leaves the child prostrate. This is when the most drastic effects of inability to walk set in, including escoliosis and osteoporosis, which also cause lung disfunction, jeapordising the child's survival.

Type 1, the most severe of the three types, is diagnosed in the first few months of life. Babies seldom make it through their first 18 months. Type 2, which the exoskeleton is aimed at combating, can be diagnosed between the first seven to 18 months of life. Children who show symptoms are unable to walk, thus leading to a serious decline in their health. Children's life expectancy is seriously affected by this lack of mobility and any respiratory infection becomes critical to over-twos. There are, however, cases of some sufferers who reach adulthood. Diagnosis of type 3 is made once a child reaches 18 months, although the symptoms don't become evident until adolescence, when sufferers lose the ability to walk. "In this final case, life expectancy is normal, though with a reduced quality of life," comments Garcia.

By using the device, Elena García and her team hope to prevent the development of escoliosis, as well as the chain of resulting conditions caused by the inability to stand upright and walk.

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