

## Exoskeletons - The New Technology in Rehabilitation

Anna Mika<sup>1</sup>, Lukasz Oleksy<sup>1,2</sup> and Renata Kielnar<sup>3</sup>

<sup>1</sup>Department of Clinical Rehabilitation, University of Physical Education in Krakow, Poland

<sup>2</sup>Zen Machines, Poland

<sup>3</sup>Institute of Physiotherapy, Faculty of Medicine, University of Rzeszow, Poland

\*Corresponding author: Anna Mika, Department of Clinical Rehabilitation, University of Physical Education in Krakow Al. Jana Pawla II 78, 31-571 Krakow, Poland, Tel: (4812)6831134; Fax: (4812) 6831300; E-mail: [anna.mika@awf.krakow.pl](mailto:anna.mika@awf.krakow.pl)

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### Editorial

Limitations of independent walking and associated with this disability are serious problem for a growing group of patients. These patients are often dependent on a wheelchair or remain chained to the bed till the end of their life. For this reason, the development of gait re-education methods, and devices for mechanically assisted gait are very important elements for maintaining or regaining high quality of daily and social life. New technologies allow for the construction of devices supporting the rehabilitation process, which unload therapist in his daily work and ensuring best execution of patient's movement pattern [1,2].

Restoration of walking abilities by various mechanical devices and locomotor training has been reported by many studies [1-3]. Mechanical devices such as gait orthoses have been shown to permit standing and walking in persons with various gait deficits. Therapy for neurological recovery of walking may include locomotor training with the use of body weight supported treadmill training by either, a robotic training system or manual placement of the feet during the treadmill walking. But many of the mechanical devices available for gait restoration have had limited success for regular use mostly due to difficulty in acquiring the necessary skill and strength to use them and the high energy costs associated with ambulation. Also the one of the limitation of activity-based therapeutic locomotor training programs is the inability to continue this therapy at home [2,3].

The most technologically advanced devices for mechanical support of the gait are exoskeletons. An exoskeleton is a wearable robot which support or, in some cases substitute for the user's own movements. The first attempts to create such devices took place 40 years ago. Although many solutions have been found since then [4,5].

Currently available powered exoskeleton can be strapped on as **wearable robots** to enhance the strength, mobility, and endurance of the wearer. They are commonly designed for military use, to help soldiers carry heavy objects (80–300 kg) while running or climbing stairs both in and out of combat. In civilian areas, similar exoskeletons could be used to help firefighters and other rescue workers survive dangerous environments. Another area of application could be medical care, nursing in particular. Assistive exoskeletons can be classified into full and partial lower limb exoskeletons depending on the number of human joints that a device runs parallel to. A full lower limb exoskeleton contains joints located alongside the hip, knee, and ankle joints. Partial lower limb exoskeletons mostly focus upon joints that work together with the knee or ankle joint [4].

From a medical point of view, exoskeleton can serve as a multipurpose medical device: as an alternative to wheelchairs,

providing mobility and increasing patient's independence in daily life. Using an exoskeleton is closer to natural human mobility than using a wheelchair. The main direction in exoskeletons development it is to have sufficient flexibility (both mechanical and control) for performing the wide range movements such as walking, walking up and down stairs, sitting and standing up. These devices are intended to be worn by the elderly and those who are physically weak. It is also an efficient supplementary tool in gait reeducation. Exoskeletons could also be applied in the area of rehabilitation of stroke or spinal cord injury patients [5-8].

Because exoskeletons are multipurpose robots their wide implementation could decrease the number of rehabilitation tools needed, and the total cost of rehabilitation. The use of exoskeletons can increase the possibilities and effectiveness of rehabilitation, especially neurorehabilitation, through intensive all day functional therapy during normal life activities. An exoskeleton could reduce the number of therapists needed by allowing even the most impaired patient to be trained by one therapist. Also training can be specifically customized for each patient.

The medical exoskeletons are a relatively new technology that has been demonstrated in some studies to be safe and effective for standing and walking in persons with paraplegia. In some studies after the therapy with exoskeleton most patients were able to walk with skill levels needed for limited community ambulation. They concluded that the waking in wearable robot had significant potential to safely facilitate over ground walking in persons with paraplegia [6-9].

The reported most notable effect of walking in exoskeletons in paralyzed patients was an emotional benefit - the ability to see the world eye-to-eye. The other evidenced positive effects were the reduction of spasticity and pain. Moreover exoskeletons offer the possibility to adapt the paralyzed person to the existing environment, rather than adapt the environment to the wheelchair.

The new technologies in gait reeducation like wearable robots unambiguously every day become an integral part of the rehabilitation process.

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