Newport Biotech Consultants

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Robotic Systems for Aiding the Therapist in the Rehabilitation of Spinal injuries and stroke patients

By K. John Morrow, Jr. President
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Every year over 8000 people suffer a traumatic spinal cord injury in the United States, and 700,000 people experience a stroke. Approximately half of spinal cord injury patients have incomplete lesions, and of these 75% regain some form of ambulatory function. In 2003 there were 700,000 stroke victims; about 1/3 of these, 273,000, were fatal. In 1999 about 1.1 million individuals suffered from some loss of function as the result of a stroke. The ambulatory capability of a large number of Americans is severely compromised.

Over the last decade interest has grown in the use of manually assisted treadmill training programs for reestablishment of ambulatory function following stroke and spinal cord injury. A portion of the patient's body weight is supported in a harness while the patient is assisted on a motorized treadmill, aimed at providing normal kinematic and temporal cues during walking. To replicate the normal gait pattern, two to three physical therapists are needed to manually assist the patient. These programs have shown considerable success, as evidenced by improved electromyographic activity, a more symmetrical walking pattern, and an ability for the patient to bear more weight on their legs. Overall, such patients experience improved functional walking when compared to those who receive conventional gait training. While the neurobiology of this improved outcome is not thoroughly understood, it is proposed that the training activates afferent receptors in the lower limbs, generating the necessary sensory feedback needed to retrain neuronal networks in the

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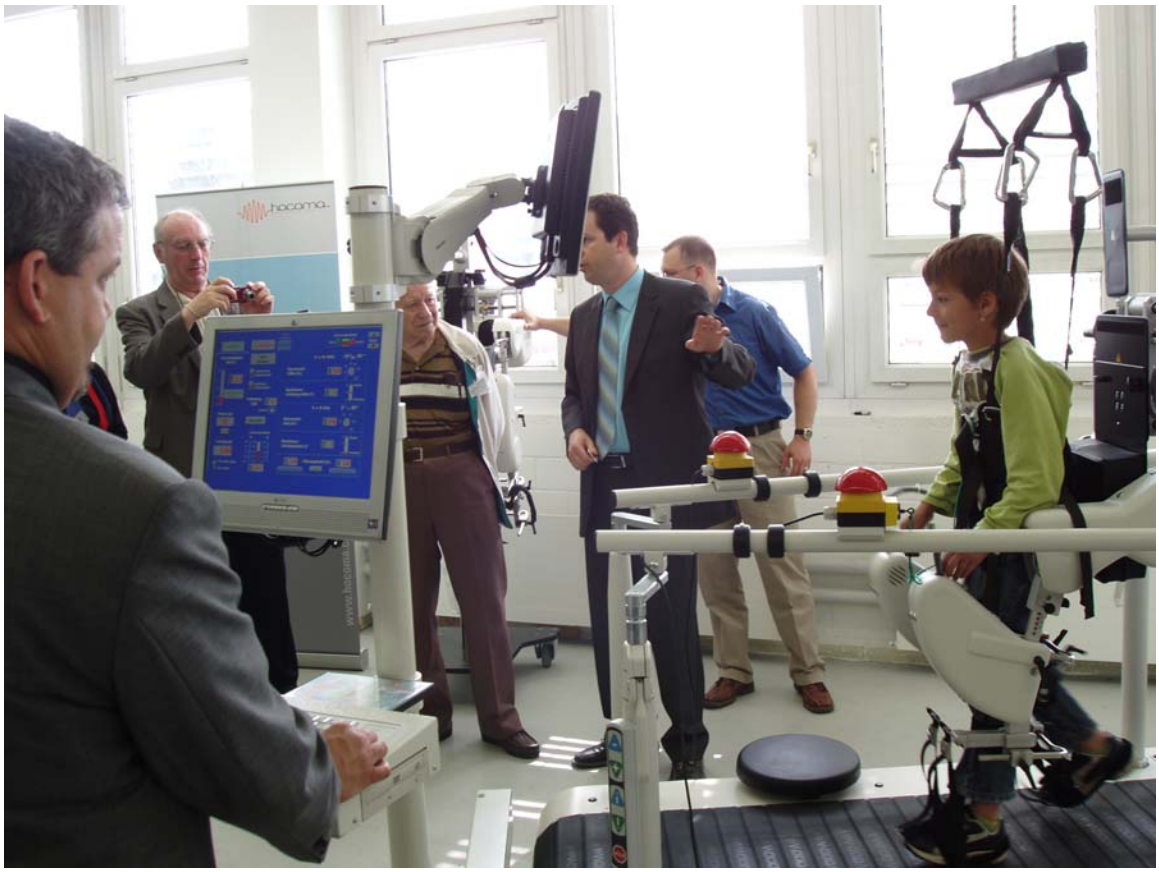
spinal cord essential for locomotion.

Despite the proven benefits of this therapy, its value is severely limited by two substantial barriers. First, is the fact that the manual training sessions require several physical therapists to assist the patient's movements through the gait cycle, and secondly, the program places severe physical demands on the therapists, who are unable to perform the training for much over 15 minutes. Because of these cost and personnel limitations, the benefits of this treatment are reaching far less than the number of eligible individuals.

The science of robotics offers a potential solution to this challenge. Recent advances in robotics technology automate gait training using actuated devices that help move the individual's legs through well-specified and consistent walking patterns as (s)he walks on a treadmill. Such robotic devices offer a number of important advantages, including improved patient safety, consistency, and the ability to prolong the training sessions indefinitely. And because of the increased safety from falls, patients adopt a more natural gait pattern, rather than a guarded, cautious stance.



Hocoma CEO's son does a demo of the apparatus during a Location Switzerland media tour in 2006.

Several research groups have evaluated robotic devices that can assist gait rehabilitation, with the goal to reduce demands on the therapist, while increasing the training time kinematic repeatability.

(Robotic Systems contd after editorial on page 3)

Editorial Comment on Recent Economic Crisis

By K. John Morrow, Jr.

Two weeks ago my wife and I were on a tour for journalists of the micromechanical industry in Switzerland. We spent hours interviewing and talking to company representatives, university researchers, regional development directors, and the other tour participants. Over and over again we compared and discussed the differences between every facet of Swiss and American life.

Here's a story that I think gets to the heart of the difference between our societies. In the early 80s the Swiss watch industry, after 200 years, reached a crisis that threatened to obliterate it. Digital watches from Japan were flooding the market and Swiss companies were hurting. Swiss watch executives got together and brainstormed (without any government involvement) as to how they could salvage the industry. The hit upon a brilliant, two point plan: (1) continue and press their advantage in the high end, prestige watch market (Rolex, Patek-Phillipe) selling them as a statements of affluence, rather than as timepieces; (2) develop high quality, inexpensive digital watches that would be so cheap and charming they could be used as a fashion statement (Swatch).

So the Swiss salvaged an industry which today supports hundreds of thousands of workers. What did the US do (remember they also had a successful watch industry)? Well, they just gave up and handed another industry over to the Japanese.

I would put a challenge to my readers: Has there EVER been a time in recent history where US businesses, in the face of savage international competition, said "Hell no, we're not going to give up, we're going to use all our ingenuity, creativity and inventiveness to save a sector of the American economy. And when we get through, maybe the industry won't be making the kind of profits that it would have made if we'd folded and moved to China, but we will have save jobs, the self respect of the work force, the manufacturing expertise of that sector, and we will have done something decent and patriotic."

Conservatives always lecture the Joe Sixpacks about patriotism, but wouldn't this be a true example of patriotism?

(Robotic Systems contd..)

The Lokomat Gait Orthosis developed by Hocoma AG, Zurich, is the most thoroughly developed of these devices and has been recently appraised for its ability to promote supraspinal reorganization following 12 weeks of training. It is a computer controlled, motorized apparatus that helps patients through symmetrical, coordinated patterns that mimic physiological walking. It is described as an "exoskeleton" device consisting of sleeves into which the patient's legs are fitted. The cuffs are connected to small DC motors that actuate the hip and knee joints.

A study of a small group of patients was carried out at the University of Texas Southwestern Medical Center in Dallas. A major component of the study was the use of functional magnetic resonance imaging to follow changes in the brain as a result of the training. All four patients in the study showed improved activation of the sensorimotor cortical regions and cerebellar regions of the brain following the training protocol. Three of the four patients showed substantial improvement in their walking index and over-ground gait speed.

A larger, multicenter trial carried out in the US and Europe involving 20 patients found significant improvement in the subjects' gait velocity, endurance and performance of functional tasks. The authors concluded that the driven gait orthosis can bring about significant improvement in patients with incomplete spinal cord injuries.

While the Lokomat's price is not trivial at $250,000, the fact that it requires a single therapist who can focus on other aspects of the patient's recovery represents a significant benefit in terms of patient outcome.

There is a fascinating convergence of bioengineering with molecular biology taking place that promises to revolutionize the treatment motor function loss in trauma and stroke victims. Research into signaling molecules in the nervous system has pinpointed a family of substances that affect the growth and regeneration of neuronal cells. A number of trials of compounds that spur neuronal growth are underway under the guidance of pharma and biotech companies. These compounds are being evaluated in animal models at present, but will be entering into clinical trials in the next year or two. By combining pharmacological and mechanical approaches to rehabilitation, the outlook for victims of stroke and trauma should vastly improve in the near future.

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