



## FES bicycles and treadmill (locomotor) training

Christopher Reeve demonstrated to the world he recovered some movement and sensation. While he was not able to walk, did not regain bowel, bladder, or sexual function, his limited recovery is still significant. The scientific literature on spinal cord injury predicts that most recovery will occur in the first six months after injury and that it is generally complete within two years. Reeve's recovery, coming five to seven years after his injury, defied these medical expectations and had a dramatic effect on his daily life.

Why did he get better so long after his injury? Reeve believed his improved function was the result of vigorous physical activity. He began exercising the year he was injured. Five years later, when he first noticed that he could voluntarily move an index finger, Reeve began an intense exercise program under the supervision of Dr. John McDonald at Washington University in St. Louis.

Reeve included several activities in his program. He used daily electrical stimulation to build mass in his arms, quadriceps, hamstrings and other muscle groups. He rode a Functional Electrical Stimulation (FES) bicycle, did spontaneous breathing training and also participated in aquatherapy. In 1998 and 1999, Reeve underwent treadmill training to encourage functional stepping.

Reeve and Dr. McDonald suggested that these activities may have awakened dormant nerve pathways. The fact is, however, that it is not possible in a single experiment to know just what did occur in Reeve's nervous system. To be sure, his recovery may have been related to exercise. Dr. McDonald and other researchers and clinicians caution not to over-interpret Reeve's results. Clearly, not all people with paralysis would benefit from a similar program.

Said McDonald in the *Journal of Neurosurgery – Spine*, “Although we cannot conclude that the activity-based recovery program produced the functional benefits, we believe it was responsible for the physical benefits.”

It is true for any of us: exercise is related to better health. Because there are few, if any, negative side effects of exercise, even people who don't experience recovery in the way that Reeve had are likely to improve their well-being. For Reeve, a high quad on a ventilator, improved health was the single most important benefit of his exercise and therapy program.

Reeve's participation in exercise was motivated by the well-known benefits on cardiovascular function, muscle tone, bone density, etc. Indeed, after his participation, he experienced fewer medical complications such as bladder and lung infections. Before 1999, Reeve frequently required hospitalization – he had a total of nine life-threatening complications and required almost 600 days of antibiotic treatment. Since 1999 until his untimely death in 2004, he had not been hospitalized, had only one serious medical complication, and needed only 60 days of antibiotic treatment. These improvements in his health boosted Reeve's emotional well-being and enabled him to commit to a variety of work projects knowing he could give them his uninterrupted attention.

If Reeve's recovery of function was due to the exercise, it was a wonderful side effect. Now, scientists are undertaking detailed studies and working with large numbers of people in centers across the country to give them the chance for similar benefits.

Christopher Reeve's experience is an example of what can happen when one refuses to accept the "get used to it" dogma. Although it is not clear what caused his recovery, his improvements in function provide a source of hope and inspiration for others.

Reeve was a strong advocate for making FES technology more widely available. "I have the staff and the equipment," he said. "But what I really hope comes out of my experience is a paradigm shift in the way insurance companies do business. If insurance companies would pay for proactive therapy and equipment they would save money keeping people like me out of the hospital. People with lower level injuries would get up and get out of their chairs. It's a win-win proposition."

Here is a rundown on the various activities in Reeve's exercise program: (Note: Before considering participation in advanced rehabilitation therapies, such as FES or treadmill training, it is important to be evaluated by one's own physician to ensure that the therapies are appropriate and safe.)

### **Functional Electrical Stimulation (FES):**

Reeve did one hour of exercise at least three times a week on an FES bicycle. This technology allows persons with little or no voluntary leg movement to pedal a stationary leg-cycle called an ergometer. Computer generated, low-level electrical pulses are transmitted through surface electrodes to the leg muscles; this causes coordinated contractions and the pedaling motion.

FES bikes are not new; they have been on the market for over 20 years. There are two companies now manufacturing FES bikes, Therapeutic Alliances, Inc., makers of the Ergys 2 (which Reeve used) and Electrologic, makers of the StimMaster Orion (used and endorsed by Reeve prior to the Ergys 2). These bikes are not cheap – they are in the range of \$15,000. Some insurance companies have reimbursed for units. There are bikes available in some community settings, at health clubs and rehab clinics. See below for contact information; the Paralysis Resource Center has a list of clinics that use FES bikes.

The first step is to choose a bike that is mechanically sound. All the electronics are upgradeable from the manufacturers. Each bike has a program cartridge set up for the specific needs of each rider, including run times, resistance, etc. A prescription is needed to get the cartridge. For safety reasons, it's not recommended that FES bike riders use another's cartridge.

Abundant medical literature documents the effectiveness of FES to increase muscle mass and improve cardiopulmonary function. There are studies that also link FES to a reduced frequency of pressure sores, improved bowel and bladder function and decreased incidence of urinary tract infections. Until now, there have been no reports in the literature linking FES to functional improvements of the sort Reeve experienced.

According to Dr. McDonald, the FES bike can be more useful than for just building muscle mass. "We propose to use them for a totally different reason -- to promote regeneration and recovery of function. We now have data demonstrating that [FES] activity can enhance regeneration in animals and is associated with recovery of function in humans."

**Treadmill or locomotor training, also known as weight-supported ambulation:**

(Note: While Reeve had used locomotor training and spoken in support of the research and its beneficial outcome, it was not a part of Reeve's latest exercise routine.)

Locomotor training is a rehabilitation approach that has been emerging over the last decade. It involves a kind of activity-triggered learning whereby practicing a series of specific movements (in this case, stepping) triggers the sensory information that somehow reminds the spinal cord how to initiate stepping.

Treadmill training uses repetitive motion to teach the legs how to walk again. A paralyzed person is suspended in a harness above a treadmill; this reduces the weight the legs will have to bear. As the treadmill begins to move, therapists move the person's legs in a walking pattern. The theory that drives the work is that paralysis causes "learned non-use" of muscles. But the injured nervous system may be "plastic," that is, capable of recovery when certain conditions, including the patterned neural activity that accompanies treadmill walking, are optimized.

Research from the University of California at Los Angeles and in Germany, Switzerland and Canada, notes that the spinal cord itself appears to act like a small brain and is thus capable of controlling ambulation. The spinal cord makes many routine decisions about the correct way to walk. When a paralyzed person is retrained to walk, both the brain and spinal cord figure out new ways to do it.

Many people with paralysis, regardless of time elapsed since onset, have improved their walking after receiving locomotor training. The level of recovery is different for each person, although almost all those with incomplete injuries showed gains.

It is important to understand, however, that locomotor training is an evolving procedure and may not help everyone to walk better. Scientists, physicians and therapists are still learning the best way to train and which patients can benefit the most. While locomotor training is part of the rehab experience for many Europeans, there is little expertise on how to do it and it is not widely available in the U.S. This is due to change soon as the commercialization of the technology moves forward.

As treadmill units filter out into the community, it is important for people to recognize that a locomotor training program must include highly trained therapists to work with patients. Maximizing a patient's ability to step after injury depends to a very large extent on the skill and precision with which the therapists deliver locomotor training.

### **Aquatherapy:**

Christopher Reeve demonstrated the ability to move his legs and arms in a pool. The effects of gravity are greatly reduced in water so that small body movements can be more easily detected and therapists can determine a person's maximum ability to move without the full resistance of gravity. Also, when people are beginning to recover movement, water makes practice easier. Time permitting, Reeve did aquatherapy once a week for approximately two hours.

### **Bone density treatment:**

Since people with paralysis don't typically put weight or pressure on their bones, they tend to lose bone density and often develop osteoporosis. With drugs and exercise on the FES bicycle, Reeve's osteoporosis had been reversed, and he regained normal bone density.

### **FES Resources**

Therapeutic Alliances, Inc. makes and markets the Ergys 2 and supports the older Regys bikes. Contact the company at 937-879-0734 or visit the Internet site, [www.musclepower.com](http://www.musclepower.com) or [www.ERGYS.com](http://www.ERGYS.com)

Electrologic was the manufacturer of the StimMaster Orion FES bikes. A new generation bike called the Galaxy was introduced in the fall of 2002. Note that Electrologic went out of business in mid-2005.

Dr. John McDonald has founded an activity-based therapy using FES equipment that is called **Restorative Therapy**.

<http://www.restorative-therapies.com/>

1-800-609-9166

A list of clinics and facilities that use FES bikes is available from Paralysis Resource Center Information Specialists.

For factsheets and references or background on FES and its other applications, contact an information specialist at the **Cleveland FES Information Center**, toll-free at 1-800-666-2353, or visit the Internet site <http://fescenter.org/index.php>

Other FES links:

[http://www.bioness.com/Prospective\\_Users/Bioness\\_for\\_Hand\\_Paralysis/Getting\\_Started.php](http://www.bioness.com/Prospective_Users/Bioness_for_Hand_Paralysis/Getting_Started.php)

Bioness for Hand Paralysis

[http://www.bioness.com/Prospective\\_Users/Bioness\\_for\\_Foot\\_Drop/Getting\\_Started.php](http://www.bioness.com/Prospective_Users/Bioness_for_Foot_Drop/Getting_Started.php)

Bioness for Foot Drop

<http://www.sci-therapies.info/FES.htm>

Institute of Spinal Cord Injury, Iceland: FES Overview  
(Note: Vocare is no longer available in the U.S.)

<http://www.sigmedics.com/TheParastep/>

Parastep I System from Sigmedics, Inc.

<http://www.sigmedics.com/FESQandA/>

Parastep FAQ

### **Treadmill or locomotor training resources:**

The UCLA group has developed a treadmill-training device under the brand Robomedica. The advantage of this system is the depth of expertise in the development team, led by prominent researchers Reggie Edgerton and Susan Harkema. This is the unit Reeve used; it is also the system being used in clinical trials for spinal cord injury currently underway in the U.S. and Canada. Contact Robomedica at 310-393-5883.

Mobility Research, based in Tempe, AZ, has been selling a harness and treadmill training set up for about 8 years. The LiteGait system can be purchased directly for about \$10,500 (the pediatric model is \$2250) plus the treadmill, at \$2950. The company says it has many stories of paralyzed users getting function back. Its treadmill trainers are available around the U.S. Contact them at [www.litegait.com](http://www.litegait.com) or toll free 1-800-332 WALK (9255).

Other locomotor systems are coming to the market. The Lokomat, from Switzerland, is being tested at the Rehabilitation Institute of Chicago and the National Rehabilitation Hospital in D.C. The Miami Project to Cure Paralysis also has a Lokomat. The device is described as an exoskeleton (an external skeleton) with robotic joints at the hip and knee to guide the user's legs as they step along the treadmill. The technology is intended to reduce the need for some of the therapists during a training session. See the device at <http://www.hocoma.com/en/>

HealthSouth, the big rehab center chain, has introduced the AutoAmbulator, a harness and treadmill rig inspired by a visit to UCLA's treadmill program several years ago. The company rolled out the product early in 2003, beginning at their inpatient rehab facilities. Contact [www.healthsouth.com](http://www.healthsouth.com) for more.

The main clinical trial for treadmill training in the U.S. is being conducted by the National Institute of Child Health and Human Development (NICHD). The protocol calls for people with incomplete injuries within 35 days of onset. The trials will randomly assign patients to either the experimental group, which receives 12 weeks of specialized treadmill training with regular physical therapy, or to the control group, which receives 12 weeks of regular physical therapy. The ability of the patients to "walk" will be measured before and after treatment as well as 6 and 12 months later, using tests that examine mobility independence and speed of ambulation. The trials are ongoing at six sites in the U.S. and Canada:

- Rancho Los Amigos Medical Center, near Los Angeles.
- Shepherd Center in Atlanta
- Ohio State University, Columbus
- Thomas Jefferson University Hospital, Philadelphia
- University of Ottawa, Ottawa, Ontario, Canada
- McGill University, Montreal, Quebec, Canada

For more detail on the NICHD clinical trials see <http://clinicaltrials.gov> -- type the word treadmill in the search box.

The U.S Department of Veterans Affairs is backing three clinical trails to evaluate treadmill training. One, in Cleveland, is enrolling people who have had a stroke; part of the trial will also involve neuromuscular stimulation. Contact Janis Daly, Ph.D., 216-791-3800, [rir@po.cwru.edu](mailto:rir@po.cwru.edu).

The VA Rehabilitation Research and Development Service is enrolling people who had a stroke in a Houston trial of treadmill training. Contact Elizabeth Protas, 713-794-7117, [lim.peter@houston.va.gov](mailto:lim.peter@houston.va.gov)

The third trial, also in Houston, is enrolling people with SCI to compare supported treadmill training to conventional gait training for improving gait speed, gait endurance, gait efficiency and muscle function. SCI subjects need to be injured more than six months prior to start of training. Contact Sally Holmes, M.D., 713-794-7128.

### **Christopher & Dana Reeve Foundation has launched the NeuroRecovery Network**

The endgame for the Reeve Foundation is to translate discovery science findings to the clinic and to that end, the Foundation, through a Grant/Cooperative Agreement with the Centers for Disease Control and Prevention, has created the NeuroRecovery Network. This is a strategic program to develop specialized Centers to deliver intensive activity-based rehabilitation treatments to people with spinal cord injury and other select neurological disorders, based on continually evolving scientific and clinical evidence. The initial treatment offered is Locomotor Training using body weight support on a treadmill. In this new form of rehabilitation, patients are hoisted over treadmills and helped to move their feet in stepping motions. Over time, as they repeat the stepping

movements again and again and gradually bear more weight, their spinal cords below the injury level seem to reawaken and activate the leg and foot muscles involved in walking and standing. The NeuroRecovery Network is the latest in the Reeve Foundation's expanding research strategy to develop and deliver effective therapies to people who are spinal cord injured. For more detail on the NeuroRecovery Network please visit the [www.ChristopherReeve.org](http://www.ChristopherReeve.org) , Click on NeuroRecovery Network on the left hand side.

Interested in learning more about the NRN? [Click here](#) to download a brochure or call for a brochure.

To apply to become a patient of the NeuroRecovery Network, please click on the link below of the center(s) where you'd like to receive therapy. (*note: please fill out a form for each center you're interested in applying to*).

- **Frazier Rehab Institute**, Louisville, KY  
*Linda Shelburne*; [linda.shelburne@jhsmh.org](mailto:linda.shelburne@jhsmh.org)
- **Magee Rehabilitation Hospital**, Philadelphia, PA  
*Mary Schmidt Read*; [mschmidt@mageerehab.org](mailto:mschmidt@mageerehab.org)
- **The Institute for Rehabilitation & Research**, Houston, TX  
*Daniel Graves*; [dgraves19@houston.rr.com](mailto:dgraves19@houston.rr.com)
- **Shepherd Center**, Atlanta, GA  
*Sarah Morrison*; [sarah\\_morrison@shepherd.org](mailto:sarah_morrison@shepherd.org)
- **Boston Medical Center**, Boston, MA  
*Jane Wierbicky*; [jane.wierbicky@bmc.org](mailto:jane.wierbicky@bmc.org)
- **Kessler Institute For Rehabilitation**, West Orange, NJ  
*Sue Ann Sisto*; [ssisto@kmrrec.org](mailto:ssisto@kmrrec.org)
- **Ohio State University Medical Center**, Columbus, OH  
*D. Michele Basso*; [Basso.2@osu.edu](mailto:Basso.2@osu.edu)

#### **Our Community Fitness and Wellness Facilities:**

- **Courage Center**, Minneapolis, MN  
Contact Rachel Kath-Dvorak at [rachel.kath-dvorak@couragecenter.org](mailto:rachel.kath-dvorak@couragecenter.org)
- **Frazier Rehab Institute** – Community Fitness and Wellness Facility, Louisville, KY  
Contact Karey McDowell at [Karey.McDowell@jhsmh.org](mailto:Karey.McDowell@jhsmh.org).  
[Find out more and download the application here.](#)
- **NextSteps Chicago**, Willow Springs, IL  
Contact Jon O'Connor, Director, [nextstepschicago@gmail.com](mailto:nextstepschicago@gmail.com)

- [NextStep Fitness](#), Lawndale, CA  
Contact Janne Kouri, [management@nextstepfitness.org](mailto:management@nextstepfitness.org)
- [Neuroworx](#), South Jordan, UT  
Contact Dale Hull, M.D., Executive Director, [info@neuroworx.org](mailto:info@neuroworx.org)

## FES RESOURCES

| Name  | Programs  | Contact Information  |
|---|---|--|
| PEERS Program<br>Los Angeles Medical Group<br>8912 Olympic Boulevard<br>Beverly Hills, CA 90211   | Neuromuscular treatments<br>Cardiovascular exercise<br>Bicycle ergometry<br>Lower limb movement | Dr. Paul Berns, Medical Director<br>Phone: 310-553-4833<br>Fax: 310-553-4833                         |
| FES Parastep Ambulation Program for SCI<br>Long Beach Memorial Rehabilitation Hospital<br>701 E. 28th Street, Suite 416<br>Long Beach, CA 90806 | Lower limb movement<br>Stepping and walking   | Ann Vasile, MD<br>Phone: 310-424-8111<br>Fax: 310-492-6830   |
| Mark W. Vogel, MD<br>8635 West Third Street,<br>#1060 W<br>Los Angeles, CA 90048  | Sexual function<br>Electroejaculation   | Mark W. Vogel, M.D.<br>Phone: 310-652-2973<br>Fax: 310-289-0187                                      |
| Functional Electrical Stimulation on SCI Patients<br>West Los Angeles VA Medical Center<br>11301 Wilshire Boulevard<br>Los Angeles, CA 90073    | Cardiovascular exercise<br>Bicycle ergometry  | A.M. Erika Scremin, MD<br>Karen L. Perell, Ph.D.<br>Phone: 310-824-3124 x 7088<br>Fax: 310-824-3125  |
| Spinal Cord Injury Unit<br>VA Medical Center-San Diego<br>3350 La Jolla Village Drive<br>San Diego, CA 92161                                    | Neuromuscular treatments<br>Regaining voluntary function  | Dr. Susan Szollar<br>Dr. Kevin Gurhart<br>Dr. Marc Kelly<br>Phone: 619-552-7453<br>Fax: 619-552-7452 |
| Yale University School of Medicine<br>333 Cedar Street, 121 FMB   | Respiratory treatments<br>Breathing assistance  | John A. Eleftheriades, M.D.<br>Phone: 203-785-2705<br>800-432-7898<br>Fax: 203-785-3346              |

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| New Haven, CT 06520-7898  |  |   |
| FES at Newington Children's Hospital<br>Newington Children's Hospital<br>181 Cedar Street<br>Newington, CT 06111  | Cardiovascular exercise<br>Bicycle ergometry   | Phillip B. Arnold, M.D.<br>Phone: 203-667-5582<br>Fax: 203-667-5284   |
| The Miami Project to Cure Paralysis<br>University of Miami School of Medicine<br>1600 N.W. 10th Avenue, R-48<br>Miami, FL 33136                             | Lower limb movement<br>Stepping and walking<br>Upper limb movement<br>Grasping<br>Sexual function<br>Electroejaculation  | Maria Amador, R.N.<br>Phone: 305-243-6001<br>800-782-6387<br>Fax: 305-243-6017  |
| Rehabilitation Services Center for Rehabilitation Medicine<br>Emory University Department of Rehabilitation<br>1441 Clifton Road, N.E.<br>Atlanta, GA 30322 | Neuromuscular treatments<br>Regaining voluntary function   | Steven L. Wolf, PhD, FAPTA<br>Phone: 404-712-4801<br>Fax: 414-712-4809<br>Email: <a href="mailto:steve@spinal.emory.edu">steve@spinal.emory.edu</a>                   |
| Shepherd Center<br>2020 Peachtree Road,<br>NW Atlanta, GA 30309   | Lower limb movement<br>Stepping and walking<br>Standing/transfer assistance  | Mytrice B. Atrice, PT<br>Phone: 404-350-7487<br>800-548-6651<br>Fax: 404-350-7356   |
| Pritzker Institute of Medical Engineering<br>Illinois Institute of Technology<br>10 West 32nd Street, E1-125<br>Chicago, IL 60616-3793                      | Respiratory treatments<br>Breathing assistance<br>Cough assistance   | Robert J. Jaeger, Ph.D.<br>Phone: 312-567-3926<br>Fax: 312-567-5705<br>Email: <a href="mailto:pimejaeger@minna.acc.iit.edu">pimejaeger@minna.acc.iit.edu</a>          |
| FES for Autonomic Dysfunction<br>Hines VA Hospital Rehabilitation R&D Center<br>(151L)<br>P.O. Box 20<br>Hines, IL 60141                                    | Respiratory treatments<br>Breathing assistance<br>Bladder control<br>Bladder emptying<br>Bladder incontinence<br>Bowel control<br>Bowel emptying<br>Bowel incontinence | James S. Walter, Ph.D.-<br>Bladder and sexual function<br>Lisa Riedy, Ph.D.-Bowel control<br>Robert Dunn, Ph.D.-<br>Respiratory control<br>Phone: 708-343-7200 x 5805 |

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|   |  | Fax: 708-531-7928  |
| Physical Medicine and Rehabilitation Service<br>Baltimore Veterans Affairs<br>Medical Center<br>10 North Greene Street,<br>Mail Stop 117<br>Baltimore, MD 21201         | Upper limb movement<br>Grasping  | Linda Marshall, M.S., OTR<br>Phone: 410-605-7171<br>Fax: 410-605-7932  |
| REGYS/ERGYS Program for<br>Spinal Cord Injured Persons<br>Medical Illness Counseling Center<br>2 Wisconsin Circle, Suite 530<br>Chevy Chase, MD 20814                   | Cardiovascular exercise<br>Bicycle ergometry   | Chaleene Frazier, RN<br>Kathy Besha, RN<br>Phone: 301-654-3638<br>Fax: 301-652-9051                              |
| Spinal Cord Injury Services<br>Physical Medicine and Rehabilitation Service<br>Brockton/West Roxbury VA<br>Medical Center<br>1400 VFW Parkway<br>West Roxbury, MA 02132 | Lower limb movement<br>Stepping and walking<br>Upper limb movement<br>Grasping<br>Neuromuscular treatments<br>Treating weak, atrophied muscles | Allen W. Wiegner, PhD<br>Phone: 617-323-7700 x 5300<br>Fax: 617-323-6693<br>Email:<br>wiegner.allen@forum.va.gov |
| FES- Leg Cycle Ergometry (LCE) Program<br>Grand Valley State University<br>School of Health Sciences<br>126 Lake Michigan Hall<br>Allendale, MI 49401                   | Cardiovascular exercise<br>Bicycle Ergometry   | Brian Curry, PhD<br>Phone: 606-895-3318<br>Fax: 616-895-2090   |
| Rehabilitation Institute of Michigan<br>Detroit Medical Center<br>261 Mack Boulevard<br>Detroit MI 48201  | Lower limb movement<br>Stepping and walking<br>Neuromuscular treatments<br>Treating weak, atrophied muscles                                    | Deneen Pucci<br>Phone: 313-745-9801<br>Fax: 313-745-1019   |
| Therapeutic Electrical Stimulation (TES)<br>Rehabilitation Medicine   | Neuromuscular treatments<br>Treating weak, atrophied   | Sharon Moore, TES<br>Clinician<br>Phone: 616-458-1088  |

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| <p>Associates<br/>515 Michigan NE, Suite 200<br/>Grand Rapids, MI 49503</p>  | <p>muscles</p>   | <p>Fax: 616-458-7809</p>  |
| <p>The Recovery Project<br/>37650 Professional Center Dr. , Suite 105A<br/>Livonia, MI 48154</p>   | <p>StimMaster<br/>FES Bicycle Ergometry<br/>Neuromuscular treatment<br/>Lower limb movement<br/>Upper limb movement<br/>Stepping and walking<br/>Grasping</p>  | <p>Rebecca Lindemann, MPT<br/>Phone: 734-953-1745<br/>Fax: 734-953-1745<br/>Email:<br/><a href="mailto:info@therecoveryproject.net">info@therecoveryproject.net</a></p> |
| <p>University of Minnesota/Minnesota VA<br/>Medical Center<br/>111 Church Street, SE<br/>Minneapolis, MN 55455</p>   | <p>Lower limb movement<br/>Stepping and walking</p>  | <p>William K. Durfee, Ph.D.<br/>Phone: 612-625-0099<br/>Fax: 612-624-1398<br/>Email:<br/>wkdurfee@maroon.tc.umn.edu</p>   |
| <p>Parastep/ERGYS - REGYS The Rehabilitation Institute<br/>3011 Baltimore Kansas City, MO 64108</p>  | <p>Cardiovascular exercise<br/>Bicycle ergometry<br/>Lower limb movement<br/>Stepping and walking<br/>Circulatory/Skin treatments<br/>Treating pressure sores<br/>Lower limb movement<br/>Standing/transfer assistance</p> | <p>Linda Jessen, PT<br/>Randy Leighton, PT<br/>Phone: 816-756-2250<br/>Fax: 816-756-5217</p>  |
| <p>Jefferson Barracks - Spinal Cord Injury Unit<br/>Veterans Administration - St. Louis<br/>Attn #128 JB Spinal Cord Injury Unit<br/>Building 52<br/>St. Louis, MO 63125</p> | <p>Cardiovascular exercise<br/>Bicycle ergometry<br/>Neuromuscular treatments<br/>Treating weak, atrophied muscles</p>   | <p>Dr. Jai Park<br/>Phone: 314-894-6677<br/>Fax: 314-845-5039</p>   |
| <p>Barnes Jewish Hospital at Washington University Medical Center<br/>Box 8111 660 S. Euclid<br/>St. Louis, MO 63110</p>   | <p>Bowel and Bladder control<br/>Cardiovascular training<br/>Neuromuscular training<br/>Pain control<br/>Muscle strengthening<br/>Lower and Upper</p>  | <p>Phone: 314-454-7825<br/>Fax: 314-454-5300<br/>Email: 314-454-5300</p>  |

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|   | extremity<br>limb movement   |   |
| Physical Therapy<br>Department<br>Immanuel Rehabilitation<br>Center<br>6901 North 72nd Street<br>Omaha, NE 68122    | Lower limb movement<br>Stepping and walking<br>Lower limb movement<br>Stepping and walking   | Katherine Jones, PT<br>Phone: 402-572-2327<br>Fax: 402-572-2632   |
| "Help Them Walk Again"<br>Foundation, Inc.<br>5300 W. Charleston<br>Boulevard<br>Las Vegas, NV 89102                | Circulatory/Skin<br>treatments<br>Improving circulation in<br>limbs<br>Neuromuscular<br>treatments<br>Regaining voluntary<br>function<br>Cardiovascular exercise<br>Bicycle ergometry  | JoAnne Toadvine, Ph.D.<br>Phone: 702-878-8360<br>Fax: 702-878-9508  |
| Universal Institute, Inc.<br>Rehabilitation and Fitness<br>Center<br>383 Ridgedale Avenue<br>East Hanover, NJ 07936 | Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Cardiovascular exercise<br>Bicycle ergometry   | Jerry Lasso, Executive<br>Director<br>Joanne Witterschein, PT,<br>Director<br>of Rehabilitation<br>Phone: 201-887-5881<br>800-468-5440<br>Fax: 201-887-8917 |
| Kessler Institute for<br>Rehabilitation, Inc.<br>1199 Pleasant Valley<br>Way<br>West Orange, NJ 07052               | Cardiovascular exercise<br>Bicycle ergometry<br>Circulatory/Skin<br>treatments<br>Treating pressure sores<br>Lower limb movement<br>Stepping and walking<br>Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Regaining voluntary<br>function<br>Sexual function<br>Electroejaculation | Sue Schweer, PT. Physical<br>Therapy Director<br>Phone: 201-731-3600<br>800-648-0296<br>Fax: 201-243-6842   |
| FES Induced Extremity<br>Ergometry<br>The Mount Sinai Medical<br>Center<br>Asphalt Green, Fourth                    | Cardiovascular exercise<br>Bicycle ergometry   | Susan Pollack Feldman<br>Phone: 212-987-3171<br>Fax: 212-987-3175   |

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| Floor<br>555 E. 90th Street<br>New York, NY 10128  |   |   |
| Parastep<br>Burke Rehabilitation<br>Center<br>785 Mamaroneck Avenue<br>White Plains, NY 10605  | Lower limb movement<br>Stepping and walking   | Vicki Clark<br>Phone: 914-948-0050<br>Fax: 914-684-0358   |
| Parastep System<br>Good Samaritan Hospital<br>3217 Clifton Avenue<br>Cincinnati, OH 45220-<br>2489                                       | Lower limb movement<br>Stepping and walking   | Nancy Hake, PT<br>Phone: 513-872-2481<br>Fax: 513-872-3473  |
| Mellen Center<br>Cleveland Clinic<br>Foundation/Mellen<br>Center<br>9500 Euclid Avenue U10<br>Cleveland, OH 44195-<br>5244               | Neuromuscular<br>treatments<br>Controlling spasticity<br>Lower limb movement<br>Stepping and walking<br>Treating weak, atrophied<br>muscles<br>Controlling pain   | Daniel Kelly, PT<br>Phone: 216-444-8619<br>216-444-8608 (voice mail)<br>800-223-2273 x 4-8619<br>Fax: 216-445-6259<br>Email:<br>kellyd@ccsmtp.ccf.org   |
| Cleveland FES Center<br>Cleveland VA Medical<br>Center<br>Motion Study Laboratory<br>151W<br>10701 East Boulevard<br>Cleveland, OH 44106 | Lower limb movement<br>Standing/transfer<br>assistance<br>Stepping and walking  | Jane Marek, RN, ext. 5109<br>Carol Bieri, MS, PT, ext.<br>3834<br>Phone: 216-791-3800 X<br>3009<br>FAX: 216-231-8886<br>Email:<br>cleve_fes@po.cwru.edu |
| The Ohio State University<br>2154 Dodd Hall<br>480 W. Ninth Avenue<br>Columbus, OH 43210   | Cardiovascular exercise<br>Bicycle ergometry  | James Baldi, PhD<br>Phone: 614-293-5613<br>Fax:   |
| Wright State University<br>Institute for<br>Rehabilitation<br>Research and Medicine<br>3171 Research<br>Boulevard<br>Dayton, OH 45420    | Cardiovascular exercise<br>Bicycle ergometry<br>Orthopaedic treatments<br>Circulatory/Skin<br>treatments<br>Preventing/treating<br>osteoporosis<br>Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles | Roger Glaser, PhD<br>Phone: 513-259-1326<br>Fax: 513-259-1310   |
| Physical Therapy<br>Department   | Neuromuscular<br>treatments   | Laraine A. Bauer, PT<br>Phone: 419-639-2626   |

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| St. Francis Health Care Center<br>401 N. Broadway<br>Green Springs, OH<br>44870  | Treating weak, atrophied muscles<br>Cardiovascular exercise<br>Bicycle ergometry   | 800-248-2552<br>Fax: 419-639-3412  |
| Flower Outpatient Rehabilitation Clinic<br>Flower Hospital/Rehabilitation Center<br>5200 Harroun Road<br>Sylvania, OH 43560              | Lower limb movement<br>Stepping and walking<br>Standing/transfer assistance<br>Treating weak, atrophied muscles<br>Controlling tremor<br>Regaining voluntary function<br>Enhancing neural regeneration<br>Neuromuscular treatments<br>Regaining voluntary function | Tony Perzynski, PT<br>Phone: 419-824-1985<br>Fax: 419-824-1456   |
| FES Research Program<br>Shriners Hospitals<br>Philadelphia Unit<br>8400 Roosevelt Boulevard<br>Philadelphia, PA 19152                    | Upper limb movement<br>Grasping<br>Lower limb movement<br>Stepping and walking   | M.J. Mulcahey, MS, OTR/L<br>Phone: 215-332-4500<br>800-281-4050<br>Fax: 215-332-5766<br>Email:<br>mulcahey@astro.ocis.temple.edu |
| Parastep<br>Dallas Rehabilitation Institute – HealthSouth<br>9705 Harry Hines Boulevard<br>Dallas, TX 75220                              | Lower limb movement<br>Stepping and walking  | Patricia Winchester, PhD<br>Phone: 214-351-2014<br>214-351-4012  |
| University of Utah<br>Division of Urology<br>University of Utah Health Science Center<br>50 N. Medical Drive<br>Salt Lake City, UT 84132 | Sexual function<br>Electroejaculation<br>Lower limb movement<br>Stepping and walking   | Stewart T. Landau, MD<br>Phone: 801-581-4705 x 4705<br>800-824-2073<br>Fax: 801-581-6127   |
| Parastep by Sigmedics<br>Woodrow Wilson Rehabilitation Center<br>Route 250   | Lower limb movement<br>Stepping and walking  | Kate Baxter<br>Wendy Ledbetter<br>Phone: 703-332-7110<br>800-345-9972<br>Fax: 703-332-7194                                       |

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| Fishersville, VA 22939   |  |  |
| Hunter Holmes McGuire<br>VA<br>Medical Center<br>1201 Broad Rock<br>Boulevard<br>Richmond, VA 23249  | Respiratory treatments<br>Breathing assistance<br>Lower limb movement<br>Stepping and walking  | Dr. Meena Midha<br>Phone: 804-230-1328<br>Fax: 804-230-1459                          |
| Rehabilitation and<br>Research<br>Center<br>Medical College of<br>Virginia<br>Box 980677<br>Richmond, VA 23298-<br>0677  | Lower limb movement<br>Stepping and walking  | Dr. William O. McKinley<br>Phone: 804-828-0861<br>Fax: 804-828-5074                  |
| Neuromuscular<br>Retraining<br>Clinic<br>University of Wisconsin<br>Hospital and Clinics<br>2710 Marshall Court<br>Madison, WI 53711   | Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Upper limb movement<br>Grasping<br>Regaining voluntary<br>function   | Beth Stellberg, PT<br>Phone: 608-263-2935<br>Fax: 608-265-4011                       |
| Functional Electrical<br>Stimulation<br>"Marcelo J. Fite"<br>Rehabilitation<br>Institute<br>Av. Santa Fe 5380 14 "E"<br>Buenos Aires 1425<br>Argentina                           | Lower limb movement<br>Stepping and walking<br>Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Controlling spasticity<br>Upper limb movement<br>Other-shoulder and<br>forearm                                    | Freehand Sotelano, MD<br>Phone: 54-1-772-5200<br>Fax: 54-1-802-6962<br>54-1-802-6962 |
| FES Clinic, Hamstead<br>Centre<br>Spinal Injuries Clinic<br>Royal Adelaide Hospital<br>Spinal Injuries Service<br>Hampstead Road<br>Northfield, Adelaide SA<br>5085<br>Australia | Circulatory/Skin<br>treatments<br>Improving circulation in<br>limbs<br>Preventing/treating<br>pressure<br>sores<br>Upper limb movement<br>Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Controlling spasticity | Henry Rischbeith,<br>Physiotherapist<br>Phone: 08-2600641<br>Fax: 618-3497414        |

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|  | Cardiovascular exercise<br>Bicycle ergometry<br>Lower limb movement<br>Stepping and walking  |  |
| FES Centre<br>Austin Hospital<br>Studley Road<br>Heidelberg Victoria 3081<br>Australia   | Upper limb movement<br>Grasping  | Mrs. Sara Carroll<br>Phone: 03-496-3491<br>Fax: 03-496-3626  |
| Shake-A-Leg FES<br>Research<br>Program<br>The University of Sydney<br>Department of Biomedical<br>Sciences<br>Faculty of Health<br>Sciences<br>The University of Sydney<br>Sydney 2141 Australia                 | Cardiovascular exercise<br>Bicycle ergometry<br>Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Controlling spasticity<br>Lower limb movement<br>Stepping and walking<br>Standing/transfer<br>assistance | Dr. Glen Davis, FACSM<br>Phone: 61 2 646-6200<br>Fax: 61 2 646-4853<br>Email:<br>g.davis@cchs.su.edu.au                      |
| Restoration of Hand<br>Grasp and<br>Release Using FES<br>Royal North Shore<br>Hospital<br>Spinal Injuries Unit and<br>Biomedical Engineering<br>Pacific Highway, St.<br>Leonards<br>Sydney NSW 2065<br>Australia | Upper limb movement<br>Grasping  | Dr. Tim Scott<br>Dr. James Middleton<br>Phone: 02-926-7226<br>Fax: 02-906-1685<br>Email:<br>trsb@cortex.physiol.su.oz.a<br>u |
| Vienna Working Group<br>FES<br>University of Vienna<br>Department of Biomedical<br>Engineering and<br>Physics<br>AKH Ebene 4/L<br>Waehringerguertel 18-20<br>Vienna A-1097 Austria                               | Lower limb movement<br>Stepping and walking<br>Respiratory treatments<br>Phrenic Pacemaker   | H. Thoma; M. Bajak<br>Phone: 0043-1-40400-1984<br>Fax: 0043-1-40400-3988<br>Email:<br>m.bijak@bmt.p.akh-<br>wien.ac.at       |
| Neuromuscular Electrical<br>Stimulation - N.M.E.S.<br>Department of Biomedical<br>Unicamp<br>State University of<br>CampinasEngineering  | Lower limb movement<br>Stepping and walking<br>Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles  | Prof. Dr. A. Cliquet, Jr.<br>Phone: 55-192-397895<br>Fax: 55-192-393346/391395   |

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| Unicamp - Biomedical engineering - C.P. 6040<br>Campinas<br>San Paulo 13081-970<br>Brazil  | Sensory aids<br>Sensation/feedback<br>Upper limb movement<br>Grasping  |  |
| FES for Spinal Cord Injured<br>Patients<br>Hospital Das Clinicas Da Faculdade de Medicina<br>Rua diderot, 43<br>Sao Paulo 04116-030<br>Brazil  | Circulatory skin treatments<br>Upper limb movement<br>Neuromuscular treatments<br>Orthopaedic treatments<br>Sensory aids         | Silvia Mazzali Souza<br>Luis Henrique Cuzziol<br>Claudete Lourenco<br>Phone: 55-011-549-0111<br>Fax: 55-011-549-0556           |
| FES for Spinal Cord Injured<br>Patients<br>Biomedical Engineering Laboratory-<br>Polytechnical School-USP Divisao De Reabilitacao, Hospital Da<br>Faculdade de Medicina<br>Av. Prof. Luciano Gualberto, travessa 3, No. 158<br>Sao Paulo 05508-900<br>Brazil | Lower limb movement<br>Stepping and walking<br>Standing/transfer assistance  | Jose Carols Teixeira de Barros<br>Morases, PhD<br>Phone: 55-011-818-5718<br>Fax: 55-011-818-5718<br>Email: tbm@doc.poli.usp.br |
| Division of Neuroscience<br>University of Alberta<br>513 Heritage Medical Research Centre<br>Edmonton Alberta T6G 252<br>Canada  | Upper limb movement<br>Grasping<br>Neuromuscular treatments<br>Controlling tremor<br>Lower limb movement<br>Stepping and walking | Marguerite Wieler<br>Phone: 403-492-5749<br>Fax: 403-492-1617  |
| Therapeutic Electrical Stimulation<br>Magee Clinic/Mayatek Medical<br>5160 Yonge Street, Suite 505<br>North York Ontario M2N 6L9 Canada  | Neuromuscular treatments<br>Treating weak, atrophied muscles   | Dr. Karen Pape<br>Dr. Sarah C. Muttitt<br>Phone: 416-733-1783<br>800-742-8173<br>Fax: 416-733-1721                             |
| G.F. Strong F.E.S. Study<br>University of Alberta<br>British Columbia  | Lower limb movement<br>Stepping and walking<br>Neuromuscular   | Maura Whittaker, B.Sc.R<br>Phone: 604-737-6237<br>Fax: 604-737-6359  |

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| Rehabilitation<br>Society<br>G.F. Strong Centre<br>4255 Laurel Street<br>Vancouver British<br>Columbia<br>V5Z-2G9 Canada  | treatments<br>Treating weak, atrophied<br>muscles   |  |
| Acute Spinal Cord Injury<br>Unit<br>Vancouver Hospital and<br>Health<br>Sciences Centre<br>855 West 12th Ave.<br>Vancouver British<br>Columbia<br>V6R 3C3 Canada                        | Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Regaining voluntary<br>control  | Hilary Jebson<br>Phone: 604-875-5805<br>Fax: 604-875-5811                                |
| S.M.I. Center for<br>Sensory-<br>Motor Interaction<br>Department of Medical<br>Informatics and Image<br>Analysis<br>Aalborg University<br>Fredrik Bajers Vej 7D<br>Aalborg 9000 Denmark | Lower limb movement<br>Stepping and walking   | Thomas Sinkjaer, PhD<br>Phone: 45-98158522<br>Fax: 45-981540080<br>Email: ts@miba.auc.dk |
| Centre for Spinal Cord<br>Injured<br>The Neuroscience Centre<br>National University<br>Hospital<br>Fysiurgisk Hospital<br>Hvnevej 25 DK-3100<br>Hornbaek Denmark                        | Lower limb movement<br>Upper limb movement<br>Muscle strengthening<br>Grasping<br>Sexual function<br>Electroejaculation<br>Cardiovascular exercise<br>Bicycle ergometry | Fin Biering-Sorensen<br>Phone: 45-42-20-08-04<br>Fax: 45-42-20-10-33                     |
| FES for Verticalization,<br>CALIES, Bladder<br>Centre for Propara<br>263 Rue de Caducee<br>Monpellier Cedexs 34195<br>France  | Bladder control<br>Lower limb movement<br>Neuromuscular<br>treatments   | Dr. Emmanuel Rabischong,<br>PhD<br>Phone: 33-67046704<br>Fax: 33-67046700                |
| FES for Paraplegic<br>Patients<br>Klinik Berlin<br>Department of Neurologic<br>Rehabilitation<br>Free University Berlin<br>Berlin 14089 Germany   | Lower limb movement<br>Stepping and walking   | Stefan Hesse<br>Phone: 49130136503-102<br>Fax: 49130136503-222                           |

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| <p>Restoration of Stance and Gait by FES</p> <p>Restoration of Stance and Gait by FES</p> <p>Neurologic Clinics<br/>Klinikum Grosshaddeum of University<br/>Marchioninistrasse 15<br/>Munich D-81377<br/>Germany</p> | <p>Lower limb movement</p> <p>Stepping and walking</p> <p>Stair climbing</p>                      | <p>Dr. Jochen Quintern</p> <p>Phone: 49-89-70906118</p> <p>Fax: 49-89-70906101</p> <p>Email:<br/>u73lar@sunmail.lrz.munche<br/>n.de</p> |
| <p>Neurological Surgery for Treatment of the Neurogenic Lower Urinary Tract</p> <p>Department of Urology<br/>University<br/>Witten/Herdecke<br/>HeusnenstraBe 40<br/>Wuppertal 42283<br/>Germany</p>                 | <p>Bladder control</p> <p>Bladder incontinence</p>  | <p>J.W. Thurdooff, MD</p> <p>Markus Hohenfellner, MD</p> <p>Phone: 0202-896-2263</p> <p>Fax: 0202-896-2139</p>                          |
| <p>Treatment of Spasticity</p> <p>National University Hospital</p> <p>Eiriksgata 29<br/>Reykjavik 101 Iceland</p>  | <p>Neuromuscular treatments</p> <p>Controlling spasticity</p> <p>Regaining voluntary function</p> | <p>Thordur Helgason</p> <p>Phone: 354-560-1595</p> <p>Fax: 354-560-1291</p> <p>Email: thordur@rsp.is</p>                                |
| <p>FESTIM</p> <p>Lowenstein Rehabilitation Center</p> <p>Department of Biomechanics</p> <p>P.O. Box 3<br/>Raanana 43100 Israel</p>   | <p>Lower limb movement</p> <p>Stepping and walking</p>  | <p>Dr. E. Isakov</p> <p>Phone: 972-9-909090</p> <p>Fax: 972-9-446666</p> <p>Email:<br/>jm@biomed.technion.ac.il</p>                     |
| <p>NESS C5 (C6) FES System</p> <p>Multi-Center Study</p> <p>NESS Ltd. And Unita' Spinale</p> <p>Azienda Ospedaliera Careggi-<br/>C.T.O. Unita' Spinale</p> <p>Large Palagi 1<br/>Firenze 50100 Italy</p>             | <p>Upper limb movement</p> <p>Grasping</p>  | <p>Dr. Aito Sergio</p> <p>Phone: 0039-55-4278417</p> <p>Fax: 0039-55-4278417</p>  |
| <p>Spasticita e FES in Paienti</p>   | <p>Lower limb movement</p> <p>Stepping and walking</p>  | <p>Dr. Ruggero Prati, MD</p> <p>Dr. Vittorio Alfieri</p>  |

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| Mielolesi<br>Public Hospital<br>Ospedale di Lonato-<br>Desenzano<br>Divisione di<br>Neuroriabilitazione<br>Lonato (Brescia) 25017<br>Italy              | Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Controlling spasticity<br>Controlling tremor<br>Circulatory/Skin<br>treatments<br>Improving circulation in<br>limbs | Phone: 30-991 39 33<br>Fax: 30-991-39 33   |
| FES in the Restoration of<br>Grasp<br>III University of Rome<br>Facolta' di Ingegneria<br>Via Eudossiana 18<br>Roma 00184 Italy                         | Upper limb movement<br>Grasping   | Prof. Tommaso D'Alessio<br>Phone: 39-6-44585657<br>Fax: 39-6-6873300<br>Email:<br>dalessio@infocom.ing.uniroma1.it |
| P.M. & Rehabilitation<br>Osaka Rosai Hospital<br>1179-3, Nagasone –<br>CHO<br>Sakai Osaka 591 Japan   | Respiratory treatments<br>Cough assistance  | Jiro Kawamura<br>Phone: 0722-52-3561<br>Fax: 0722-55-3369  |
| Sendai FES Project<br>Tohoku University<br>2-1 Seiryomachi, Aoba-<br>ku<br>Sendai 980-77 Japan  | Bladder control<br>Lower limb movement<br>Upper limb movement<br>Neuromuscular<br>treatment<br>Orthopaedic treatments<br>Respiratory treatments<br>Sensory aids                           | Yoshio Kiyoshige<br>Phone: 81-022-273-9014<br>Fax: 81-022-274-0608   |
| Department<br>Rehabilitation<br>Medicine<br>Free University Hospital<br>De Boelelaan 1117<br>Amsterdam 10071 HV<br>Netherlands                          | Sexual function<br>Electroejaculation   | Dr. Becher<br>Phone: 31-20-4440763<br>Fax: 31-20-4440202<br>Email: jharlaar@cca.vu.nl                              |
| Electrical Bladder<br>Stimulation<br>in Spinal Cord Injury<br>University Hospital St.<br>Radboud<br>P.O. Box 9101<br>Nijmegen NL-6500 HB<br>Netherlands | Bladder control<br>Bladder emptying<br>Bladder incontinence   | Phillip E.V. Kerrebroeck,<br>MD, PhD<br>Phone: 32-80-613920<br>Fax: 31-80-541032                                   |
| Electrical Stimulation in   | Upper limb movement   | Prof. Jerry Kiwerski, MD,  |

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| <p>Treatment of Spinal Cord Injuries<br/>Metropolitan Rehabilitation Center<br/>Wierzejewskiego 12<br/>Konstancin 05-511<br/>Poland</p> | <p>Grasping<br/>Neuromuscular treatments<br/>Enhancing neural regeneration</p>  | <p>ScD<br/>Phone: 48-22-56-40-61<br/>Fax: 48-22-56-46-80</p>   |
| <p>Universitet of Medicine Proznan, Poland<br/>28 czerwca 1956 r<br/>135/147<br/>Poznan 61-545 Poland</p>                               | <p>Bladder control<br/>Bladder emptying<br/>Neuromuscular treatments<br/>Treating weak, atrophied muscles</p>   | <p>Dr. Przemyslaw Lisinski<br/>Phone: 0-61-310-217<br/>Fax:</p>  |
| <p>F.E.S. Hospital Geral St. Antonio<br/>Service De Fisiatria<br/>Largo Prof. Able Salazar<br/>Porto 4000 Portugal</p>                  | <p>Lower limb movement<br/>Stepping and walking<br/>Standing/transfer assistance<br/>Neuromuscular treatments<br/>Treating weak, atrophied muscles</p>  | <p>Maria Joao Andrade<br/>Phone: 351-2-5483191<br/>Fax: 351-2-320318</p>   |
| <p>Centre for Implantable Technology and Sensors<br/>IT IS d.o.o. Ljubljana<br/>Lepi pot 11<br/>Ljubljana 6100 Slovenia</p>             | <p>Lower limb movement<br/>Stepping and walking</p>   | <p>Dr. Janez Rozman<br/>Phone: 386-61-1251-161<br/>Fax: 386-61-266-508</p>   |
| <p>Routine and Research FES Programs<br/>Rehabilitation Institute<br/>Linhartous 51<br/>Ljubljana 6100 Slovenia</p>                     | <p>Lower limb movement<br/>Stepping and walking<br/>Circulatory/Skin treatments<br/>Treating pressure sores<br/>Bladder control<br/>Bladder incontinence<br/>Respiratory treatments<br/>Cough assistance<br/>Sexual function<br/>Electroejaculation</p> | <p>Prof. Dr. Martin Stefancic<br/>Phone: 061-1375188<br/>Fax: 061-1372070</p>                                      |
| <p>FES for Lower Extremities after SCI<br/>Faculty of Electrical and Computer Engineering<br/>Republic Slovenia</p>                     | <p>Lower limb movement<br/>Stepping and walking</p>   | <p>Professor Alojz Kralj<br/>Phone: 386-61-1768-411<br/>Fax: 386-61-264-990<br/>Email: kralj@robo.fer.unilj.si</p> |

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| Rehabilitation Institute<br>Trzaska 25<br>Ljubljana 61111 Slovenia   |   |   |
| International Therapeutic<br>Technology<br>Roman Macaya, 23, Pral.<br>4a<br>Barcelona 08022 Spain  | Lower limb movement<br>Stepping and walking<br>Cardiovascular exercise<br>Bicycle ergometry<br>Neuromuscular<br>treatments<br>Treating weak, atrophied<br>muscles<br>Regaining voluntary<br>control   | Larry Lawhorn, OT<br>Phone: 343-212-0543<br>Fax: 343-212-0543                         |
| Institut Guttmann<br>Garcilaso S7<br>Barcelona 08027 Spain   | Bladder control<br>Bladder emptying<br>Bladder incontinence<br>Bowel control<br>Bowel emptying<br>Bowel incontinence<br>Sexual function<br>Erection/ejaculation<br>Lower limb movement<br>Stepping and walking<br>Standing/transfer<br>assistance | Joan Vidal<br>Phone: 93-3512211<br>Fax: 93-3493237                                    |
| Electrical Stimulation for<br>Spinal<br>Cord Injured: Unidad de<br>Lesionados Medulares<br>Hospital Juan Canalejo<br>Las Jubias, 84<br>La Coruna 15006 Spain | Lower limb movement<br>Stepping and walking   | Dr. Salvador de la Barrera,<br>SCI unit<br>Phone: 034-81-171817<br>Fax: 034-81-178001 |
| University of Bristol<br>Bristol Royal Infirmary<br>Clinic 8 level 5<br>Marlborough Street<br>Bristol BS28 1 TW<br>United Kingdom                            | Lower limb movement<br>Stepping and walking<br>Bowel control<br>Bowel incontinence  | Dr. Rosie Jones<br>Phone: 44-117-928-3022<br>Fax: 44-117-928-2470                     |
| Restoring Lower Limb<br>Functions in Paraplegics<br>with<br>a Multichannel<br>Lumbosacral<br>Motor Root Stimulator<br>Implant<br>Medical Research            | Lower limb movement<br>Standing/transfer<br>assistance<br>Stepping and walking  | Dr. Nick N. Donaldson<br>Phone: 0171-380-9700<br>Fax: 0171-380-9700                   |

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| <p>Council<br/>(MRC)<br/>c/o Department of<br/>Medical<br/>Physics and<br/>Bioengineering<br/>University College<br/>London<br/>1st Floor Shropshire<br/>House,<br/>11-29 Capper Street<br/>London WC1E 6JA<br/>United Kingdom</p>  |   |  |
| <p>Evaluation of a Hybrid<br/>Walking<br/>Orthosis Combining<br/>Functional Electrical<br/>Stimulation with the<br/>Reciprocating Gait<br/>Orthosis<br/>North Western Orthotic<br/>Unit-<br/>Clinical Sciences<br/>Building<br/>Hope Hospital - Eccles<br/>Old<br/>Road<br/>Salford M6 8HD<br/>United Kingdom</p> | <p>Lower limb movement<br/>Stepping and walking</p>   | <p>Mrs. L. Sykes<br/>Phone: 44-0161-787-4242<br/>Fax: 44-0161-787-4241<br/>Email:<br/>epowlee@fsi.ho.man.ac.uk</p> |
| <p>Sacral Anterior Root<br/>Stimulation for Impaired<br/>Bladder<br/>Function Duke of<br/>Cornwall<br/>Spinal Injured Centre<br/>Salisbury District<br/>Hospital,<br/>Salisbury<br/>Salisbury Wiltshire SP2<br/>8BJ United Kingdom</p>  | <p>Bladder control<br/>Bladder emptying</p>   | <p>Tony Tromans<br/>Phone: 0711-336262 x 2437<br/>Fax:</p>   |
| <p>Duke of Cornwall Spinal<br/>Treatment Centre<br/>Department of Medical<br/>Physics<br/>and Biomedical<br/>Engineering</p>  | <p>Lower limb movement<br/>Standing/transfer<br/>assistance<br/>Stepping and walking<br/>Upper limb movement<br/>Grasping</p> | <p>Paul Taylor<br/>Phone: 1722-336363 x 4065<br/>Fax: 1722-325904</p>  |

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| Salisbury District Hospital<br>Salisbury Wiltshire SP2<br>8BJ United Kingdom   |  |  |
| FES Standing, Walking<br>and<br>Continence<br>Department of Medical<br>Physics<br>Royal Hallanshire<br>Hospital<br>Glossop Road<br>Sheffield S10 2JF<br>United Kingdom | Lower limb movement<br>Stepping and walking<br>Bladder control<br>Bladder emptying | Dr. Ben Heller<br>Phone: 44-114-271-2734<br>Fax: 44-114-271-3403 |

### Articles

[http://sci.washington.edu/info/newsletters/articles/03sp\\_body\\_weight\\_support.asp](http://sci.washington.edu/info/newsletters/articles/03sp_body_weight_support.asp)

University of Washington's SCI Update Spring 2003: Body Weight Supported Treadmill Training.

Maddox, Sam. FES Comes of Age. New Mobility June 2006. p. 46-49, 66.

The following books and videos are available for free loan from the PRC library. For more information, please see [www.paralysis.org](http://www.paralysis.org) and click the Lending Library tab.

### Videos

**Scientific American Frontiers: Season XI Bionic Body.** Hosted by Alan Alda.

Distributed by PBS Home Video [www.pbs.org](http://www.pbs.org) (60 minutes).

Various segments include an interview of Christopher Reeve and a portion on FES.

**Wired for Life: Functional Electrical Stimulation.** By Carol Moore-Ede for the Canadian Broadcasting Corporation. Distributed by Fanlight Productions (800) 937-4113 or [www.fanlight.com](http://www.fanlight.com). (48 minutes). DVD and VHS

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