Research in spinal cord injury continues to increase in the field of “cure or regeneration research”. At the same time, researchers proceed with investigating ways to improve the quality of life for SCI survivors in areas such as prevention of recurring infections and how to lessen pain. This information sheet presents some different types of research, sponsoring research agencies, and where to go for further information.

A frustrating fact in any research is that it takes time. One method of research involves collecting and evaluating information about a particular group of individuals with spinal cord injury. Researchers may look at issues such as how persons with SCI care for themselves, medical problems and treatments used, and their daily activities. Other forms of research begin with laboratory experiments in a controlled setting or “test tube” research. These studies then progress to animal research and then to clinical trials with humans.

“Research for the Cure” or Regeneration Research

Research for finding a cure for spinal cord injury seems to move very slowly and this can be discouraging. This is because the spinal cord is a very complex part of the body. Researchers are continually learning new information about the spinal cord, its cells, and how the nerves work. In regeneration or cure research the focus is on four different areas:

1- how to keep damaged nerves and cells at the site of the injury alive;
2- how to replace damaged or lost tissue and stimulate the remaining nerves to grow and regenerate;
3- how to find what factors inhibit or keep nerve cells in the central nervous system from growing; and
4- identifying rehabilitation methods that can promote recovery after injury.

Let us look at some current research goals for each of these four main problem areas.

1- How can the death of nerves and cells at the site of the spinal cord injury be prevented?

The damage to the spinal cord takes place because of the initial trauma or from swelling and blood loss to the site that occurs for a time after the injury. The less damage to the spinal cord, the greater the chances of recovery. Researchers recently found that the use of a steroid drug, methylprednisolone (MP), reduces swelling at the injury site. It is now the “standard of care” given to all individuals within 8 hours after injury.

Another new drug, Sygen®, recently was used in a clinical trial test phase where it was administered to individuals within 72 hours of their injury. This study was done at 22 participating centers in the U.S. Researchers are now evaluating Sygen® for its role in decreasing cell death and improving chances for regeneration or the recovery of injured cells.

Still, another treatment method being studied is the moderate lowering of an individual’s body temperature shortly after the injury.

2- How can damaged tissue be replaced & the remaining nerves stimulated to grow and regenerate?

Sometimes nerves in the spinal cord are damaged permanently and unlike other tissue in the body, can not repair themselves. Furthermore, the physical damage to the spinal cord and its surrounding cells leaves an area that does not allow for new growth and healing. Researchers are trying to encourage new growth by transplanting cells or tissues at the damaged site. Previously, when researchers transplanted adult nerve cells, they did not work. There have been successful results however in laboratory animals with the transplantation of fetal nerve cells taken from an unborn animal.

Dr. Richard Fessler, University of Florida (Gainesville), Shands Hospital, in collaboration with Dr Paul Reier, transplanted spinal cord tissue from an aborted human embryo to the spinal cord with syringomyelia (a fluid filled cavity). A second patient received the same procedure in April, 1998. At 6 months post-surgery, both patients are stable and show MRI evidence of graft growth but it is still too early to draw any conclusions.
Because of the controversy in using fetal cells, researchers are looking for other alternatives to use. Through genetic engineering scientists can make new “cell lines” that supply nerve cells for grafting. Cell lines have primarily been used to provide growth factors. This use of transplanted “cell lines” is still in the animal research stage.

Scientists have found an area in the brain, and recently an area in the spinal cord, that have stem cells. These stem cells are able to divide and produce more nerve cells or neurons. The researchers’ next goal is to remove stem cells from a person with SCI, get the cells to divide in the lab, and then inject them back into the spinal cord of the person. This method would avoid problems with cell rejection.

During the past ten years, researchers discovered certain chemicals called “growth factors”. These growth factors nourish nerve cells and help cells grow during their developing stages. Their goal is to find which growth factors best improve the health of the damaged neurons and increase nerve fiber growth after an SCI.

A new drug, 4-aminopyridine (4-AP), helps nerve signals pass along a damaged area of a nerve cell, improving the nerve-impulse signal across the site of injury. It might also help individuals with SCI recover some sensory and motor function. 4-AP is currently in the early clinical trial phase with humans at selected rehabilitation centers across the country.

3- What chemicals are present in the central nervous system that prevent the growth of nerve cells.

Researchers know that scar tissue can form at the site of the spinal cord injury and block nerves from growing. Now they have also identified some chemicals that can stop nerve regeneration. The researchers are looking for ways to help the growing nerve fibers overpower those chemicals that inhibit their growth. They are studying ways to supply both the physical support for the nerve cell tissue and a healthy environment for growth.

4- What rehabilitation methods can promote recovery after injury.

Researchers are investigating a “central pattern generator” (CPG) in the spinal cord. The CPG is a group of nerve cells recently identified in animals that synchronize muscle activity when stepping. There is increased evidence that this is also present in humans. Current research is examining if this movement/exercise therapy might influence return of function in humans. In Germany a research project has individuals with SCI using a treadmill while at the Miami Project individuals use a monorail suspension system. Researchers also are conducting studies on clinically manipulating the CPG.

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**Research to Improve Rehabilitative Outcomes and Quality of Life**

As individuals with spinal cord injury live longer and more productive lives, researchers investigate ways to ensure better health and more satisfying life-styles. Also, as people age with SCI, there is an increased risk for developing other medical and psychological problems that can decrease their quality of life.

The eighteen Model SCI Care System Centers across the U.S., funded by the National Institute on Disability and Rehabilitation Research (NIDRR), collect information and conduct research on quality of life, adjustment to injuries, secondary complications, and community re-integration issues. For information on locating a Model SCI Center see SCI InfoSheet #2, “Locating Information on SCI” or search the web at - http://www.spinalcord.uab.edu/modsys96.htm.

Some current research projects of the Model SCI Centers include ways to:

1- **Ease one’s adjustment to SCI by:**
   - Establishing advocacy groups for individuals with SCI.

   - Understanding cultural issues related to SCI.
   - Developing assistive devices for use by individuals with SCI.

2- **Improve quality of life for individual’s with SCI through:**
   - Clinical trials of new drugs that may improve function.
   - Increasing potential for fertility in males with SCI.
   - Assessing the quality of life after injury of individuals with C1-C4 tetraplegia.
   - Comparing health care and recovery of patients with SCI by their insurance plans.
   - Evaluating satisfaction of individuals who received upper extremity tendon transfer.
   - Studying long term affects of SCI on an aging population.

3- **Prevent secondary complications by:**
   - Preventing deep vein thrombosis.
   - Finding improved methods of pressure ulcer management.
• Delivering accessible women’s health care.
• Providing information on risks of substance abuse and SCI.
• Improving materials for bowel management.
• Improving methods for detecting sepsis (infection).

4- Enhance community re-integration by:
• Providing independent living follow-up services.
• Reducing barriers to employment.
• Assessing personal assistant services.
• Improving utilization of independent living services.

All Model SCI Centers contribute data to the National Spinal Cord Injury Statistical Center database. These collected data help researchers better understand and evaluate SCI.

NIDRR also funds three Rehabilitation Research and Training Centers (RRTCS). They are:

❖ The RRTC on Secondary Conditions of SCI at the Department of Physical Medicine and Rehabilitation / University of Alabama at Birmingham.
   Their research priorities for the next five years include investigating interventions to prevent and treat secondary medical conditions that include pressure ulcers, respiratory complications, urinary tract infections, pain, obesity, depression.

❖ The RRTC on Aging and SCI at Los Amigos Research and Education Institute, Downey, CA.
   Topics for research include cardiovascular and pulmonary aspects of aging with SCI, bone loss across ethnic groups; activities of daily living; employment; and depression.

❖ The RRTC in Community Integration for Individuals with SCI, TIRR, Houston, TX.
   Areas of research involve developing techniques to improve personal and psychological adjustment after SCI; improving and maintaining health status; identifying gender and cultural differences relevant to community integration; and options for marriage, sexuality, reproduction and parenting.

Additional research projects to improve rehabilitation outcomes and quality of life are also funded by various private and federal agencies and drug manufacturers.

Research to Improve Function

While research for the cure continues, scientists are also working on ways to maximize the physical capabilities of individuals with spinal cord injury. Some recent trials are in the areas of Functional Electrical Stimulation (FES) and tendon transfers. FES uses a low-level electrical current applied to the neuromuscular system. The electrical stimulation replaces the brain’s original nerve impulses when spinal cord injury interrupts the natural pathway. One uses it to improve movement or function, as in assisting a person with paraplegia to stand. Another use is therapeutic, as in strengthening weakened muscles.

A tendon transfer involves surgery that releases a portion of an active muscle and attaches it to a paralyzed muscle to enhance a desired motion. Tendon transfers can be used alone or with FES.

In August, 1998, the FDA approved the use of the NeuroControl Freehand System, that restores hand grasp in persons with tetraplegia (quadriplegia). It combines FES technology, known as neural prosthetics, with tendon transfer. Other current areas of FES research are a “stand and transfer” device to help individuals with paraplegia transfer, devices that stimulate the sacral nerve to allow bladder and bowel control, and exercise machines to improve body strength.

For more information on research in this area contact the FES Information Center, 11000 Cedar Ave, Suite 230, Cleveland, OH 44106-3052; 216-231-3257 or web site at http://feswww.fes.cwru.edu or the Miami Project in Florida (see funding resources).

Research studies continue in the area of male fertility. Scientists are studying ways to improve the sexual function in males following SCI and identify causes of infertility.

A new therapeutic approach to rehabilitation of movement is beginning pilot work using the Constraint Induced Therapy combined with training protocol. This form of therapy is designed to increase the function of the lower extremities in individuals with incomplete spinal cord injury. This therapy has been used, with promising results, in people who have had a stroke.

Conclusions

There are many promising developments in the area of spinal cord injury research. In studies for “cure” research, many are still in the laboratory and animal testing stages. It is likely that no one single therapy or discovery will be the “cure” for SCI, but that multiple therapies will provide the most successful results.
Private Funded Research Centers / Programs

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Christopher Reeve Paralysis Foundation
500 Morris Ave, Springfield, NJ 07081
888-711-HOPE
http://www.apacure.com
The Christopher Reeve Foundation merged with the American Paralysis Association to work to raise funds for medical research on effective treatments and ultimately a cure for SCI. Supports programs that improve the quality of life for people with disabilities.

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Center for Neuroscience & Regeneration Research
Stephen G Waxman, Md, PhD, Director
Yale University / VA Medical Center, West Haven, CT
203-785-4086
stephen.waxman@yale.edu
Collaboration of PVA/EPVA, the VA, and Yale University to conduct research focusing on understanding SCI, finding new treatments, and ultimately a cure.

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Kent Waldrep National Paralysis Foundation
Luis F Parada, MD, Director
16415 Addison Rd, Suite 550, Addison, TX 75001
877-SCI-CURE
http://www.kwnpf.org
Supports the Kent Waldrep Foundation Center for Basic Neuroscience Research at UT Southwestern Medical Center, Dallas. Works to facilitate a cure for paralysis.

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The Miami Project to Cure Paralysis
University of Miami School of Medicine
PO Box 016960, Mail Locator R-48, Miami, FL 33101
800-782-6387
http://www.miamiproject.miami.edu
A comprehensive research center dedicated to finding more effective treatments and ultimately a cure for paralysis resulting from SCI. Research areas include basic science, interventions to improve function, and treatment for pain.

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NeuroScience Center-Rutgers University
Wise Young, MD, PhD, Director
604 Allison Rd - D413, Piscataway, NJ 08854
732-445-6573
sciproj@biology.rutgers.edu

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Rick Hansen Institute-National Neuroscience Network
Univ of British Columbia, Vancouver, BC, Canada V6T121
604-822-4433 or 604-822-1849
nthomps@rick-hansen.ubc.ca
http://rickhansen.com
To help generate funds and find a cure for paralysis.

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Spinal Cord Research Foundation
Paralyzed Veterans of America
801 Eighteenth St, NW, Washington, DC 20006
800-424-8200 or 202-416-7659
Supports research designed to develop new medical treatment therapies, improve inpatient and outpatient clinical care and develop innovative rehab therapies and assistive devices. In Spring 1998, approved funding for 20 new studies: 8 in basic science, 4 clinical studies, a conference, a development project and 6 fellowships.

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Spinal Cord Society
Rt 5, Box22-A, Wendell Rd, Fergus Falls, MN 56537
218-739-5252
http://users.aol.com/scsweb/private/scshome.htm
Pioneered regeneration and re-activation research, goal is to cure spinal cord paralysis through treatment and research.

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University of Florida Depts of Neurological Surgery and Neuroscience
University of Florida, Gainesville, FL
Room M-245, Medical Science Building (MSB)
352-392-3383
http://www.ufbi.ufl.edu/Dept/

Federal Funds available from:

.shiro
National Institute of Health (NIH)
Bethesda, MD 20892
http://www.nih.gov/grants/
Email: nihinfo@od31tm1.od.nih.gov

.shiro
National Science Foundation
703-306-1234
Email: info@nsf.gov

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Centers for Disease Control
1600 Clifton Rd., NE, Atlanta, GA 30333, USA
404-639-3311
http://www.cdc.gov/od/pgo/funding/funding.htm
Email: netinfo@cdc.gov

Published by:
Medical RRTC in Secondary Complications in SCI
Training Office, Room 529, UAB Spain Rehabilitation Center
619 19th St S, Birmingham, AL 35249-7330
(205) 934-3283 or (205) 934-4642 (TTD only)

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Bibliography of Regeneration Research

Below is a sampling of scientific articles found on MEDLINE related to spinal cord injury regeneration research.


