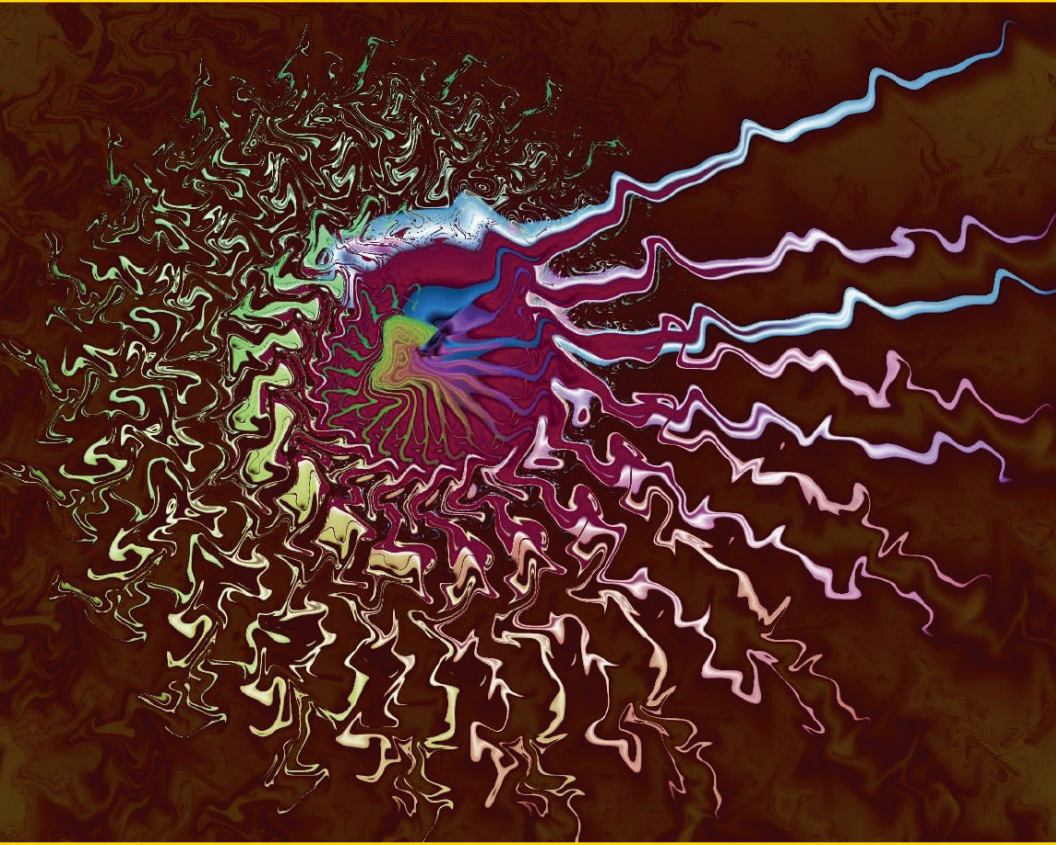


LIVING WITH PARALYSIS

Managing Spasticity



CHRISTOPHER & DANA
REEVE FOUNDATION

TODAY'S CARE. TOMORROW'S CURE.®

Second Edition 2018

This guide has been prepared based on scientific and professional literature. It is presented for the purpose of education and information; it should not be construed as medical diagnosis or treatment advice. Please consult a physician or appropriate healthcare provider for questions specific to your situation.

Credits:

Written by: Sam Maddox

Editorial Consultant: Linda M. Schultz, PhD, CRRN

Illustrations: Sven Geier

Christopher & Dana Reeve Foundation

636 Morris Turnpike, Suite 3A

Short Hills, NJ 07078

(800) 539-7309 toll free

(973) 379-2690 phone

ChristopherReeve.org

LIVING WITH PARALYSIS

MANAGING SPASTICITY



INTRODUCTION

Spasticity can be a significant health issue for many people with a spinal cord injury (SCI) or other forms of paralysis. Tumors, cysts, inflammation, or trauma can also lead to spasticity in people with a wide range of diagnoses, including cerebral palsy (CP), multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), stroke, or brain injury.

As a type of movement disorder, spasticity varies from mild muscle stiffness to severe, uncontrollable movements. Symptoms may include increased muscle tone, rapid muscle contractions, exaggerated deep tendon reflexes, muscle spasms, scissoring (involuntary crossing of the legs), and stiff joints. Spasticity may cause pain, loss of range of motion, or contracture (continuous tightening of muscle, tendons, ligaments, or skin that restricts normal movement). Spasticity can be linked to skin breakdown, broken bones and sleep disorders. It can limit many activities of daily living and the delivery of care.

The following pages describe the various causes of spasticity and options to manage it, including physical therapy and orthotic or positioning strategies as well as drug treatments, nerve blocks, internal drug pumps and surgical treatments.

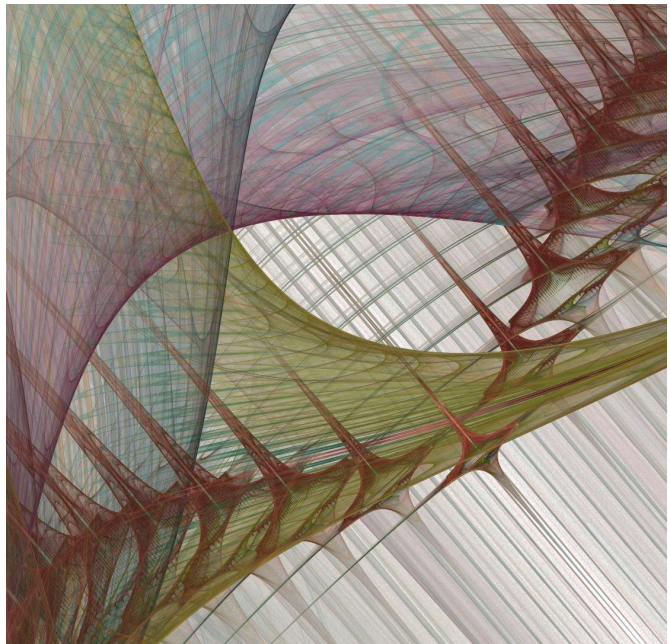


TABLE OF CONTENTS

- 1** Causes of Spasticity
- 3** Treating Spasticity: Therapies
- 4** Treating Spasticity: Medications
- 7** Treating Spasticity: Surgical Interventions
- 9** Treating Spasticity: Self-Care
- 10** Resources
- 11** Glossary

CAUSES OF SPASTICITY

Spasticity is usually the result of damage to portions of the central nervous system that control voluntary movement; the intricate balance of nerve excitation and inhibition in the brain or spinal cord is disrupted, causing reflexes to behave erratically.

Upper motor neurons, the long nerves that start in the brain and extend along the spinal cord, are responsible for voluntary movement. If these neurons are impaired, messaging to muscles can go awry.

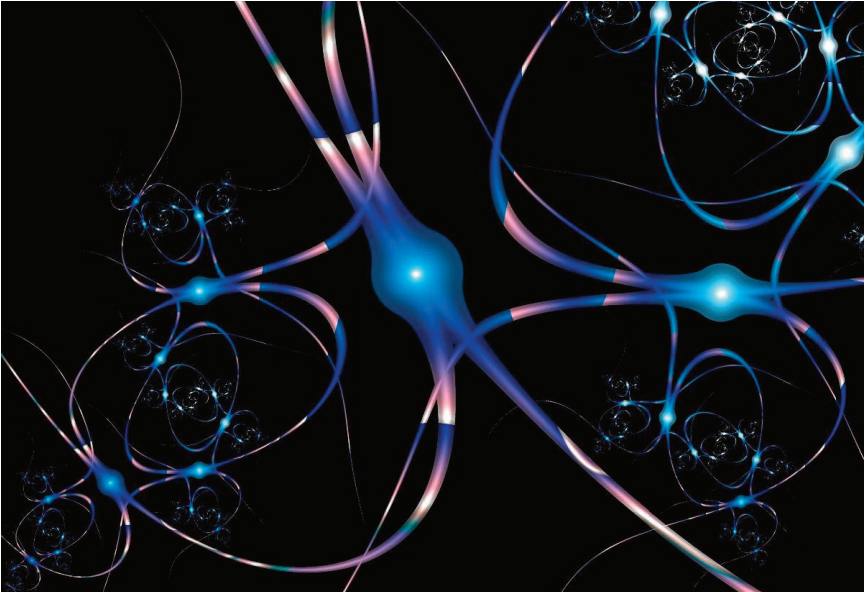
Damage to lower motor neurons, which originate up and down the spinal cord at various segments and extend into the body, can also affect motor and reflex activity. It is believed that these lower neurons sometimes sprout new synapses (the connections between nerves) following disease or trauma, thus increasing excitation or decreasing inhibition to muscle.

In the case of a recent spinal cord injury, muscles do not react because of injury and what is called spinal shock: the body's reflexes are not responding below the level of injury; this usually lasts for a few weeks. Once spinal shock subsides, reflex activity returns, but not the way it did before injury; it can be over responsive. Messages that affect muscles below the injury area are not able to reach the part of the brain that processes reflexes. The spinal cord transmits the body's exaggerated responses.

There are a multitude of reflex circuits in the central nervous system; a familiar one is the knee tendon reflex (straightening of the leg after tapping the knee with a hammer). When the hammer hits the large muscle at the knee, the thigh thinks it is stretching the tendon and the leg straightens. This is a typical response of the upper motor neurons from the brain. When the downward signals from the brain have been interrupted by a spinal cord injury or spinal disease, a wave of nerve excitement leads to unwanted muscle contractions (i.e., spasticity).

Because the reflex signals cannot reach the brain, muscle activity becomes exaggerated. This overactive muscle response is referred to by doctors as spastic hypertonia. It can manifest as uncontrollable jerking movement (known as clonus), stiffening or straightening out of muscles, shock-like contractions of a muscle or group of muscles, and abnormal tension in the muscles.

Most individuals with SCI experience spastic hypertonia in some form; persons with cervical injuries and those with incomplete injuries are more likely than those with paraplegia and/or complete injuries to experience it. The most common muscles that spasm are those that bend the elbow (flexor) or extend the leg (extensor). These usually occur as a result of an autonomic response to painful sensations or to some form of irritant below the level of injury (for example, bowel or bladder distention, skin breakdown, etc.).



Spasticity might also be a result of changes in the electrical and chemical properties of nerves themselves. Following injury or disease, the precise flow of nerve messages is disrupted along the synapse which is where the nerve messages are relayed from one nerve to another. Biomedical research hopes to better understand this complex process, leading to new and better treatments.

It should be noted that spasticity does not always require treatment; for some it can clearly be beneficial as a means of keeping muscles toned. Some people use their spasticity to empty their bladders, to assist with transfer, and even to stand or ambulate. When spasticity becomes painful or interrupts activities of daily living, treatment should be considered.

TREATING SPASTICITY: THERAPIES

Physical therapy, including muscle stretching, range of motion exercises, and other exercise regimens, are the first line of treatment.

These activities can be performed at home also; they don't need to be reserved for therapy settings. Stretching helps to maintain range of motion and prevent

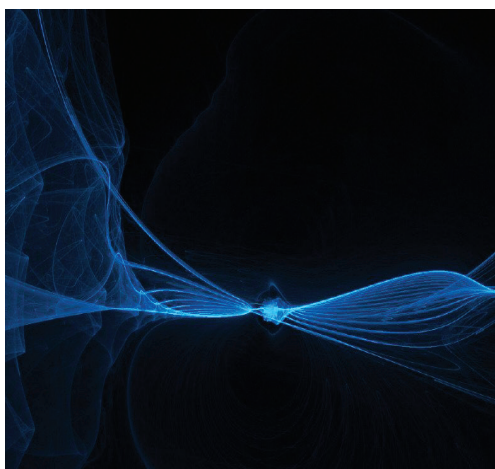
contracture (shrinkage or shortening of a muscle).

Strengthening exercises are sometimes used to restore affected muscles. Use of braces, orthoses, and casts help keep a spastic limb in a more functional position.

An ankle-foot orthosis, for example, keeps the foot flexed and reduces contracture of calf muscles. A series of successive casts is often used to gradually stretch overly tight limbs. Stretching

(whether passive or active) can be employed to prevent spasticity also.

A person living with paralysis may want to try using tilt tables, standing frames, or other body weight supported modalities to decrease the instances of spasticity.



Hippotherapy:

In small research studies with children with cerebral palsy, hippotherapy (therapy on horseback) had a positive effect on spasticity. Eight minutes of therapy resulted in improved symmetry in muscle activity. The movement of the horse is said to account for the improvements as it exhausts the spastic muscles leading to relaxation.

Vibration therapy aka Whole Body Vibration: Preliminary data suggests that vibration therapy may be useful in decreasing spasticity in adults and children with CP. In a typical vibration therapy session, the person being treated stands on the device in a static position or performs dynamic movements. In most cases, a vibration therapy session consists of several exposures to the vibration alternated by several rest periods.*

TREATING SPASTICITY: MEDICATIONS

Baclofen was designed to treat epilepsy in the 1920s; the effect on epilepsy was generally disappointing but in certain patients spasticity decreased. Baclofen (sold as Kemstro or Lioresal) is used in spinal cord injury, cerebral palsy, brain injury, spastic diplegia, multiple sclerosis, amyotrophic lateral sclerosis and trigeminal neuralgia.

Baclofen affects reflexes that emanate from the spinal cord. The drug mutes the effect of GABA (gamma-amino-butyric-acid), an essential neurotransmitter produced by the nervous system, thus damping down overactive reflex circuits.

Baclofen is commonly prescribed for spasticity and can be administered either orally or intrathecally (which means an implant under the skin delivers the drug into the canal that houses the spinal cord). Please see surgical interventions on page 8 for more information on intrathecal administration.

Tizanidine (sold as Zanaflex) is used to treat the spasms, cramping, and tightness of muscles without inducing muscle weakness. The drug is believed to work by blocking nerve impulses, and subsequent reflex activity, through inhibition of motor neurons. The drug is available in either tablet or capsule but these formulations are not equivalent. The effectiveness of capsules is primarily for short duration use and may change depending on intake of food. It is recommended that use of capsules be reserved for activities and times when spasticity relief is most important (for example, during the day or for social occasions). Tizanidine may cause low blood pressure and in some reports is linked to liver injury. In controlled studies, about 5 percent of those treated with Zanaflex had elevations in liver function tests.

Diazepam (sold as Valium) inhibits nerve activity, suppresses reflexes and relaxes muscles with some antispasticity effects. It is also a widely used sedative. Side effects are often undesirable, including hypotension, depression and tolerance. The drug can also adversely affect cognitive performance, including reduced attention, concentration and memory.

Dantrolene: This is the only drug used for spasticity that does not act upon the nervous system but rather targets muscle tissue itself. Dantrolene is effective by reducing skeletal muscle strength; it uncouples the

process of excitation-contraction in muscle fiber. The drug interferes with the release of calcium, which is necessary for normal muscle function. Major adverse effects of Dantrolene include general muscle weakness, sedation (less than Baclofen or diazepam, however), and occasionally hepatitis. There is some reported risk of liver toxicity. Some studies indicate that Dantrolene is best utilized by people with stroke or SCI. People with multiple sclerosis don't respond well to this drug.

Gabapentin (Neurontin) was developed for nerve pain but is effectively used off-label (legally prescribed but without specific Food and Drug Administration approval) for spasticity and pain management in people with spinal cord injury.

Marijuana and its derivatives have been reported anecdotally by people with spasms to help with pain and unwanted muscle tone. Doctors sometimes prescribe Marinol, a synthetic derivative of marijuana, but there is little to report on its effect on spasms; some people say it's not as effective as marijuana. Please check your local and state marijuana laws as marijuana and its derivatives are not legal in every state nor are they legal under federal law.

Nurse Linda says... *Medications that are used to treat spasticity can become ineffective over time as the body becomes accustomed to them. Increases in doses sometimes have to occur to maintain effectiveness.*

Injectable medications/nerve blocks: Phenol and alcohol injections destroy muscle or nerve tissue and therefore limit spasms. The effect is permanent. These injections are considerably more painful than botulinum toxin (botox) injections.

Botulinum A toxin (Botox) produces temporary denervation: the chemical neutralizes the junction of nerves and muscles, reducing the uncontrolled spasm. This treatment has been used as a successful therapy for improving muscle stiffness in individuals with spasticity or dystonia.

Botox is botulinum toxin which is injected into the muscle or muscle groups. Some muscle tissue is destroyed but it will recover over time. Therefore, additional injection treatments will be necessary. The duration of effect can be quite variable, from one month to six months or more.



Botox has been reported to be effective for some people with spasticity related to stroke, cerebral palsy, traumatic brain injury, spinal cord injury, or multiple sclerosis.

There are currently two available forms of botulinum toxin: botulinum toxin type A (Botox), and botulinum toxin type B (Myobloc). Both types of toxin work in the same way, but each has its own range of side effects and duration of effect. In a small percentage of users, long-term treatment with botulinum toxin can lead to the development of antibodies, which bind to the toxin and render it ineffective.

Nurse Linda says...Medications for spasticity cannot be stopped suddenly. These drugs have to be tapered off to avoid serious withdrawal complications. “Toughing it out” will not work as the affects to your body are physiological. Additionally, if you go “cold turkey” off these medications, it is likely that if you return to them your spasticity will be much more difficult to control.

TREATING SPASTICITY: SURGICAL INTERVENTIONS

Surgery/Orthopedic: Orthopedic surgery targets the muscle, tendon, or bone in a spastic limb to reduce spasticity and/or pain, and increase range of motion. The most common orthopedic procedure is a contracture release, wherein the tendon of an overly tight muscle is partially cut. The joint is then repositioned at a more functional angle, with a cast applied.

Serial casting might be used to gradually extend the joint. The most common site for contracture release is the Achilles tendon, which is lengthened to correct contracture of the calf muscles that pull the foot downward to point the toes. Other common targets for surgery are tendons of the knees, hips, shoulders, elbows, and wrists. Ankle balancing is an effective intervention made possible by moving tendons.

Osteotomy is a procedure that can correct a deformity that does not respond to other procedures. A small piece of bone is removed to allow it to be repositioned or reshaped. A cast is applied. Osteotomy is commonly used to correct hip displacements and foot deformities.

Arthrodesis fuses together bones that normally move independently; this is intended to limit a spastic muscle from pulling the joint out of position. Arthrodesis is commonly performed on ankle and foot bones.

Surgery/Neurological: Rhizotomy (sometimes called selective dorsal rhizotomy, or SDR) is a neurosurgical procedure intended to reduce spasticity. It was first used over 100 years ago, but fell out of favor due to complications (loss of motor or bladder control, etc.). Improved surgical techniques brought the procedure back into practice since the 1970s, mainly in children with cerebral palsy.

Rhizotomy involves a laminectomy, removal of part of the bony protection of the spinal canal. The preferred site for a rhizotomy is generally the lower spine between the bottom of the rib cage and the top of the hips; this affords reliable identification of dorsal roots as they exit from the spinal canal. Once all the nerve roots are exposed, doctors meticulously separate sensory nerve roots from the motor ones. The surgeon then divides each of the dorsal (sensory) roots into three or more rootlets and stimulates each electrically, thus identifying the ones related to spasticity. These abnormal rootlets are cut; normal nerves are left intact.

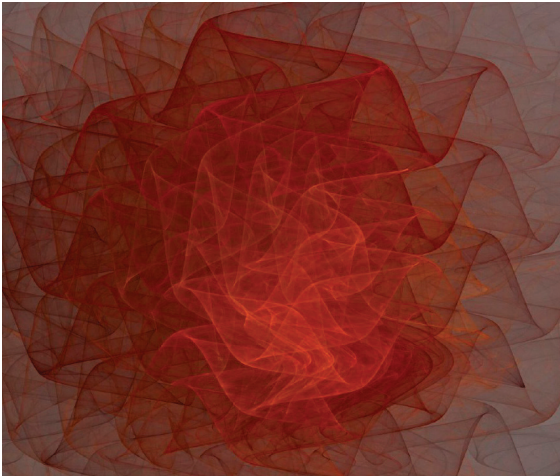
Success for the surgery varies but most children with cerebral palsy (CP) experience an immediate reduction in spasticity and an increase in range

of motion. This tone reduction may last for a number of years. Many kids become more mobile; SDR has been shown to improve sitting, standing, walking and balance control. Improvements in self-care, including bladder and bowel care, have also been reported. SDR is most often used to improve the lower extremity functions, but it can also improve gross range of motion of the upper extremities in children with relatively severe quadriplegic CP. It does not improve fine motor skills.

Clinicians have reported other benefits for SDR, including significant changes in cognitive function. Children appear to improve emotionally, too. These changes have been attributed to increased focus and less distraction from tight muscles.

SDR is sometimes performed on adults with cerebral palsy. Functional gains in adults are similar to those reported in children.

Baclofen Pump: Baclofen can be administered intrathecally (which means an implant under the skin delivers the drug into the canal that houses the spinal cord). Intrathecally-administered Baclofen, at about 1/100 the oral dose, has been approved by the Food and Drug Administration for the treatment of those who cannot tolerate oral Baclofen. Intrathecally-delivered Baclofen has fewer side effects such as a lower chance of renal and liver toxicity. Pre-testing is done to check the response of an individual to intrathecal baclofen. This is an outpatient



surgical procedure and if effective, a separate surgery to install the pump is performed. Surgery to install the pump can be expensive. Few adverse effects or complications have been reported, although tubing and pumps can get clogged or fail. Tolerance to intrathecal Baclofen has been reported.

Other drugs can be administered through the Baclofen pump--often for pain control. Intrathecal morphine has also been reported to be very effective for spasticity.

TREATING SPASTICITY: SELF-CARE

***Nurse Linda says...**Use of devices and exercise equipment at home is beneficial and can include standing frames, elastic therapy bands, or any other equipment that fatigues the muscle.*

Electrical stimulation stimulates a weak muscle to be able to oppose the activity of a stronger, spastic one. Functional electrical stimulation (FES) 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.

Changing Intensity: Most people deal with spasticity as a part of their daily routines; it is not an issue of treatment but of management. However, a change in the intensity or pattern of a person's spasticity is something to pay attention to. Changes can indicate formation of a cyst or cavity in the spinal cord (post-traumatic syringomyelia) and could lead to more spasticity. Also, problems outside the nervous system (e.g. bladder infections or skin sores) can increase one's spasticity and may require treatment.

***Nurse Linda says...**With the passage of time and the process of aging, your spasticity may change. Effective treatment of spasticity may require the use of more than one modality. Each person is unique and may require a unique combination of treatments for success. Allow time for your body to adjust to your treatment plan. Effective treatment of spasticity takes time to realize success.*

RESOURCES

If you are looking for more information on spasticity or have a specific question, Reeve Foundation Information Specialists are available business weekdays Monday through Friday, toll-free at 800-539-7309 from 9 am to 5 pm EST.

The Reeve Foundation maintains a fact sheet on spasticity resources. Please also see our repository of fact sheets on hundreds of topics ranging from state resources to secondary complications of paralysis.

Below are some additional resources on spasticity from trusted sources:

Craig Hospital: Spasticity

Craig Hospital is a model spinal cord injury and traumatic brain injury facility with numerous patient resources.

<https://craighospital.org/resources/spasticity>

Model Systems Knowledge Translation Center: Spasticity and Spinal Cord Injury

MSKTC is a national center that works to put research into practice to serve the needs of people with traumatic brain injuries, spinal cord injuries, and burn injuries.

<http://www.msktc.org/sci/factsheets/spasticity>

United Cerebral Palsy (UCP)

United Cerebral Palsy has numerous information resources on spasticity and its treatment options.

<http://www.ucp.org>

* Rauch, Frank. "Vibration Therapy". *Developmental Medicine & Child Neurology*. 2009, 51 (Supp. 4) 166-168.

GLOSSARY

Denervation: loss of nerve supply. It may be caused by disease, chemical toxicity, physical injury, or intentional surgical interruption of a nerve.

Physiological: relating to the way in which a living organism or bodily part functions.

Rhizotomy: a surgical procedure to sever nerve roots in the spinal cord. The procedure effectively relieves chronic back pain and muscle spasms.

Spinal shock: similar to a concussion in the brain. After spinal cord injury, shock causes immediate flaccid paralysis, which lasts about three weeks.

Synapse: a junction between two nerve cells, consisting of a minute gap across which impulses pass.

Syringomyelia: the development of a fluid-filled cyst (syrinx) within a spinal cord.



We're here to help.

Learn more today!

Christopher & Dana Reeve Foundation

636 Morris Turnpike, Suite 3A

Short Hills, NJ 07078

(800) 539-7309 toll free

(973) 379-2690 phone

ChristopherReeve.org

This project was supported, in part, by grant number 90PR3002, from the U.S. Administration for Community Living, Department of Health and Human Services, Washington, D.C. 20201.

Grantees undertaking projects under government sponsorship are encouraged to express freely their findings and conclusions.

Points of view or opinions do not, therefore, necessarily represent official Administration for Community Living policy.