# The Road to Rehabilitation

## Part 7 ■ Traveling Toward Relief: Dealing with Spasticity & Brain Injury

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Brain Injury Association of America

# Brain Injury Association of America

**Creating a better future through brain injury prevention, research, education and advocacy.**

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# Introduction

## What is Spasticity?

Spasticity is a condition that causes stiff, tight muscles, especially in the arms and legs. Individuals with spasticity often are unable to relax their muscles. As a result, movements are stiff, jerky or uncontrollable. Spasticity also may mask potential movement in the individual and it often occurs in people with brain injury, cerebral palsy, stroke, multiple sclerosis or spinal cord injury.

Some individuals also may experience spasms—sudden, involuntary muscle contractions similar to the muscle cramps athletes experience. Painful spasms may be triggered by something as minor as a simple movement of the arm or leg, skin irritation or a full bladder.

Spasticity results from a disorder of or injury to the central nervous system (CNS). The central nervous system—made up of the brain and spinal cord—works as a network of nerves connected to muscles. Complex messages continuously move back and forth between the muscles and the brain, using the spinal cord as a pathway. Normally, muscle groups in the nervous system work together so when one is flexed, its opposing muscle is relaxed. This helps maintain a comfortable level of muscle tone that provides support for the body and makes movement easy.

After a brain injury, the brain may not be able to send or receive these special messages. As a result, the system balance is disturbed so that muscles needlessly stay tight or contracted. This condition is known as spasticity. Spasticity varies from mild to severe, and is different for every individual.

# Treatment

## Why Treat Spasticity?

Spasticity does not always need to be treated. It can be beneficial if an increase in muscle tone results in better movement and increased function. However, if spasticity interferes with comfort or function, it should be treated. Spasticity can be painful and can make simple activities of daily living (ADLs)—walking, eating, dressing, bathing, going to the bathroom or transferring from wheelchair to bed—time consuming and difficult.

The increased stiffness in muscles may mean a great amount of energy is required to go about everyday activities. Sometimes, spasticity even can make these basic activities impossible to do alone. These problems affect not only an individual's self-care abilities, but also greatly increase the demands on a caregiver. In some cases, it becomes impossible for the caregivers to assist with or perform basic hygiene tasks for the individual who has severe spasticity.

When spasticity limits activity, it often causes additional medical problems such as pain, sleep disturbance, pressure sores and pneumonia. Untreated spasticity also can lead to serious orthopedic problems such as muscle contractures (a permanent shortening of muscle fibers). Contractures make joints difficult or impossible to move, can decrease blood circulation and can make positioning more difficult. While contractures can be treated with orthopedics, if the underlying spasticity is not addressed with spasticity management techniques, there is a high risk of the contractures recurring. Additionally, the joints of growing children also may become dislocated.

Spasticity can limit an individual's ability to socialize and enjoy hobbies and recreational activities. This can lead to social isolation and depression.

Treating spasticity properly can decrease health care costs by reducing medical complications and increasing functional ability and independence, as well as reducing the care and/or assistance needed. Treatment of spasticity also can improve the overall quality of life for the individual and the family.

## Team Treatment Approach

Because spasticity affects everyone differently, successful treatment requires a true team effort among the individual with spasticity, family members, caregivers and health care professionals. At a minimum, these teams should include the doctor (physiatrist, neurologist), individual with spasticity, family members, care providers, nurses, psychologists, physical and occupational therapists, social workers and insurance staff members. It is important that the team includes health care professionals who have experience working with individuals with brain injury.

The first step in getting quality treatment is recognizing that something can be done to relieve spasticity. Many treatment options are available today. Finding a qualified medical professional to develop a specific treatment plan based on the individual's goals and abilities is the next step. It particularly is important to identify a medical professional who has a clear understanding of the special needs and unique characteristics of individuals with brain injury.

## Goals of Treatment

There are a number of treatment options available for spasticity. Some treatments are more appropriate for certain types of individuals than others. Before starting any treatment, it is important for the individual, the family and the health care team to agree upon realistic goals so that the health care team can recommend the treatment most likely to achieve those goals. This process can help avoid the disappointment that may occur if treatments do not produce the results that the individual or family had hoped for.

A common goal for treating spasticity is to reduce painful muscle contractures. Other goals may depend on the muscles or muscle groups affected and how spasticity has affected an individual's movement and ADLs. For those who can walk, the treatment goal may be to improve their gait (walking) or simply to reduce spasticity in order to minimize the energy needed to walk. For individuals who cannot walk or who have more severe spasticity, treatment goals may include sitting more comfortably, feeding themselves or sleeping through the night. For those individuals unable to care for themselves, the goal often is to make caregiving easier and less time consuming, as well as to prevent medical complications such as pressure sores and pneumonia.

## Treating Spasticity

There are many treatments available for spasticity and outcomes are best when the treatment plan is customized for the specific patients' needs. Factors such as severity, time post-onset of the condition causing spasticity, medical stability, location, extent, prognosis and speed of complication development all play a part in the decision-making process for treating spasticity. Therefore, it is critical that the treatment team have extensive knowledge and experience in treating individuals with spasticity.

Understanding spasticity and knowing as much as possible about the benefits and drawbacks of all available treatment options is important. The health care team can work with individuals and their families to assess which treatments might be most appropriate for meeting specific treatment goals. Treatments for spasticity can be used alone or in combination and not all treatments are appropriate for every person.

### Removal of Conditions that Can Cause an Increase in Spasticity

People whose central nervous systems have been injured often have medical problems that can increase their spasticity, including skin ulcers, DVT (blood clots), kidney stones, infections and even something as minor as an ingrown toenail. A proper diagnosis and optimal treatment of these conditions is critical for successful spasticity management. Individuals with central nervous system disease or injury commonly use various medications. Some of these medications actually can make movement more difficult. The health care team should be aware of the patient's overall medical status and goals to combat spasticity effectively.

### Physical Therapy and Occupational Therapy

For most individuals, these therapies usually are the first action taken against spasticity. The goals of physical and occupational therapy are stretching muscles to maintain range of motion and prevent muscle shortening that can lead to contractures, strengthening appropriate muscles and learning ways to carry on daily activities more effectively. Physical and occupational therapists also can help individuals with assistive devices like walkers, motorized wheelchairs and instruments to help them cope with speech defects.

Frequently, individuals with spasticity require different techniques to gain maximum function and motor learning. These different techniques can include: serial casting, inhibitory casting, weight bearing and forced use activities in conjunction with Botulinum toxin injections, nerve/motor blocks, Intrathecal Baclofen Therapy™ and orthopedic procedures.

### Orthotics

Orthotics can be used in combination with other methods of spasticity management. Casts and splints may be helpful in improving range of motion in the arms and legs. By keeping the limb in a stretched position, the muscles slowly lengthen to improve range of motion at the joint. This helps prevent muscle contractures. Orthotic devices also provide joint support and stability, allowing for safer movement. They often are used in combination with other therapies such as nerve blocks and intramuscular injections.

## Oral Anti-Spasmodic Drugs (Pills)

Oral medications can improve spasticity in some individuals with mild to moderate spasticity. Because they circulate throughout the body in the bloodstream, these medications affect nearly all muscles. All oral medications used to treat spasticity have the potential for side effects that should be weighed against their benefits. The most effective dosage will depend on striking a balance between the drug's positive and negative effects. After brain injury, people are even more likely to experience the sedating affects of these medications.

*Baclofen (Lioresal®)* is a common medication used to treat spasticity. Baclofen is an anti-spasmodic that works within the spinal cord, the pathway for messages between the brain and the nerves. Side effects may include: hallucinations, confusion, sedation, loss of muscle tone, poor muscular coordination and weakness in non-affected muscles. It also takes large amounts of the medication to actually get a small amount into the CNS. Baclofen should not be discontinued suddenly because sudden withdrawal of the medication can result in hallucinations, psychoses and/or seizures.

*Diazepam (Valium®)* is absorbed rapidly, takes effect quickly and stays in the body much longer than baclofen. Although both drugs work on the CNS, diazepam is more likely to produce sleepiness, unsteadiness or short-term memory difficulties. In addition, some people can become dependent physiologically on the medication. Tolerance also can develop, so larger doses may be needed over time to achieve the same effect.

*Tizanidine hydrochloride (Zanaflex®)* is an anti-spasmodic drug that works on the CNS to decrease the muscle reflex that causes muscles to contract. It may cause increased drowsiness and also can cause liver damage. Other side effects can include dizziness, low blood pressure and dry mouth. In addition, there have been only a few publications on its use and side effects in children and young adults.
*Clonidine* is a blood pressure medication related to tizandine that also has shown efficacy in the treatment of spasticity. There have been numerous publications describing its effectiveness or usefulness in treating spasticity of spinal cord origin. Its use with spasticity secondary to acquired brain injury (ABI) is more controversial, as it may have the potential to slow motor recovery. Additionally, there only is very limited literature reporting benefits to this population.

*Dantrolene sodium (Dantrium®)* acts on the muscles themselves rather than on the CNS. It weakens spastic muscles, but it also can affect normal muscles. Dantrium is less likely to cause sleepiness and confusion. A serious side effect can be liver damage, especially in females and those over 35 years of age. Other side effects may include: drowsiness, weakness, nausea, vomiting, dizziness, diarrhea, depression and blood abnormalities.

## Intramuscular Injections

These medications usually affect only the injected muscles and should not cause side effects to the CNS. When the goal is to reduce spasticity in one or two muscles or muscle groups, injected medications are desirable because of the length of relief they provide and their low side effect profile. Injections may not be adequate to treat individuals with severe diffuse spasticity, as these individuals can require higher doses than are advocated currently. However, injections may be used in these cases in combination with the other treatments discussed. The effects of injections will vary with dosing, muscle selection and administration of other interventions.

*Botulinum Toxin A (Botox®)* is derived from the bacteria causing botulism. Injected in small doses into the affected muscle, it weakens the muscle by blocking the chemical impulses that cause the muscle to contract. While oral medication affects multiple muscle groups in the body, Botox® is most effective for managing spasticity in specific limbs or small muscle groups. Injections can relax affected muscles for three to four months before the effects wear off, though indivdual effects will vary.

Side effects include: tenderness at the injection site, local weakness and possible formation of antibodies that could make the injections less effective over time. Because tolerance can develop, there are limitations on how often and how much toxin can be injected. While the medication has not yet been approved by the FDA for spasticity treatment, it is used

routinely and the procedure is tolerated very well. At this time, experts recommend that individuals receive injections no more than once every three months and with the lowest dose possible to minimize the probability of developing tolerance to the toxin. Some individuals with dystonia (disordered tonicity of muscle) have been treated for many years and have not developed tolerance.

*Botulinum Toxin B* (*Myobloc®)* is the second product that recently has been released by the bacteria causing botulism. There is evidence that it is effective in the treatment of muscle overactivity secondary to cervical dystonia for both Botulinum toxin A responsive and A resistant patients. At the time of this writing, no publications discussing its use in spasticity have yet to appear. However, its potential utility as an intramuscular anti-spastcity agent, especially in the population who are resistant to the A toxin, will be explored in the near future.

*Phenol* is a type of alcohol that chemically blocks nerves in the affected muscles to reduce spasticity. It is similar to Botox® in length of effectiveness and type of spasticity it treats. Phenol injections may cause pain or a burning sensation when injected. Possible complications include: bleeding, swelling, pain, changes in sensation and the slight risk of a blood clot in the arm or leg that is injected. Effects of the injections usually last from two weeks to six months. In some cases, however, phenol injections have resulted in permanent effects.

## Intrathecal Baclofen (ITB®) Therapy

Using a small pump surgically placed under the skin, this therapy delivers a liquid form of *Baclofen (Lioresal® Intrathecal Baclofen injection)* directly to the fluid surrounding the spinal cord. The medication is delivered directly to the site of action at the spinal cord. It does not circulate throughout the body in the bloodstream like an oral drug, so it relieves spasticity with much lower doses. This helps reduce or eliminate the side effects common with oral baclofen while at the same time producing a greater response. ITB Therapy is effective for individuals with generalized spasticity or spasticity in large muscle groups. It can be extremely beneficial for people with dynamic tone (tone that increases with movement). It also can lead to dramatic functional improvements for individuals.

Prior to implant of the ITB pump, candidates undergo a trial to see if they would benefit from the therapy. Once implanted, the dose of ITB Therapy can be adjusted from outside the body using a computer-like programmer to deliver different amounts of medication at different times of the day, as needed. Pump refills are required every one to three months. The therapy is nondestructive and fully reversible. The most common device-related complications are kinks, dislodgements or breaks in the catheter that delivers the drug from the device into the spinal fluid. The most common drug side effects are overly loose muscles, sleepiness, upset stomach, vomiting, headache and dizziness.

ITB Therapy was approved by the FDA in 1992 for spasticity resulting from spinal cord injury and in 1996 for spasticity due to injury to the brain. ITB Therapy is most useful in the treatment of severe spasticity in the legs and trunk. Originally, patients waited a year post-injury to have a pump implanted. Today, there is a growing interest in implanting pumps earlier, thereby avoiding some of the complications of prolonged spasticity.

Other agents also have been trialed intrathecally. Clonidine, morphine and fentanyl all have demonstrated some efficacy when administered intrathecally. Trials with other agents, including tizanidine, currently are underway and may become more widespread in the future.

## Neurosurgery

These procedures include cutting nerves (neurectomy) or nerve roots (rhizotomy) to relieve spasticity. Most often, rhizotomy is used to relieve spasticity in children with cerebral palsy. In this procedure, rootlets of sensory nerve roots, which run from the spastic leg muscles to the spinal cord, are stimulated electrically. Those responding abnormally are cut. Appropriate candidates for rhizotomy include: 1) individuals with enough underlying strength to maintain and improve their function once spasticity is relieved; 2) non-walking individuals with spasticity that interferes with sitting, positioning and care; and 3) individuals whose severe spasticity causes hip dislocations or bone contractures. If an individual needs some spasticity to stand or walk, rhizotomy may impair function and may not be an appropriate treatment. Neurosurgeries are destructive, permanent procedures.

## Orthopedic Surgery

Some individuals may be candidates for orthopedic surgeries to correct deformities resulting from spasticity or to aid the effects of other spasticity treatments. These procedures include: (1) tendon lengthening to reduce spasticity by relieving tension on the muscle; (2) tendon transfer to reduce spasticity by repositioning the tendon; (3) osteotomy to correct bone alignment; and (4) severing tendons (tendonotomy). Tendonotomy means cutting the tendons in affected limbs to reduce contractures and spasticity, increase motion and, in some cases, improve functional use of the limb. The most common procedure performed is the Tendon Achilles Lengthening (TAL), which allows individuals to walk more normally by getting their heels on the ground. Outcomes after orthopedic procedures are best when the spasticity is controlled well. Additionally, orthopedic surgery can be used in combination with ITB with the general recommendation being that if both are contemplated, the pump should be placed prior to the orthopedic interventions.

## Resources

A number of health care and rehabilitation facilities offer clinics specializing in spasticity management. Look for a center that offers comprehensive spasticity management. These centers have specially trained staff and provide the most treatment options. Checking with the local hospital may be a good start.

Managing spasticity in individuals with brain injury requires a team effort among the individual, family members, caregivers and an integrated team of health care professionals. Depending on the case, the team may include the doctor (physiatrist, neurologist), the individual with spasticity, family members, care providers, nurses, psychologists, physical and occupational therapists, speech therapists, social workers and insurance staff members. It is important that the team includes health care professionals who have experience working with individuals with brain injury, who can appreciate the big picture and who can work together with the individual and family to set and reach appropriate goals.

Health care professionals should work with the individual and family to explore various treatment options and decide the best course of action for the individual. Before starting any treatment plan, it is important for the team to set realistic goals for the individual. Family members can enhance the chance of successful treatment by encouraging communication among team members, tracking the individual's progress against the goals set and providing as to their needs.

# About the Author...

Cindy B. Ivanhoe, MD, is the Director of the Brain Injury Program at the Institute for Rehabilitation and Research (TIRR) in Houston, Texas. She is on the academic faculty of Baylor College of Medicine in the Department of Physical Medicine and Rehabilitation at the University of Texas. Dr. Ivanhoe completed her brain injury fellowship at Baylor College of Medicine after completing a residency in physical medicine and rehabilitation at the University of Illinois–Chicago. She is Board Certified in Physical Medicine and Rehabilitation. Dr. Ivanhoe has lectured extensively both nationally and internationally on the treatment of spasticity, particularly as it pertains to individuals with brain injury. She also has authored multiple publications on the subject.

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For the individual with brain injury and his/her circle of support (i.e., family members, significant others, friends and co-workers) brain injury is a complex and often tumultuous journey. Although there are broad issues affecting ALL individuals with brain injury, both the road to rehabilitation and the outcome experienced by each individual are unique. In this series of brochures, BIA seeks to educate individuals and organizations about rehabilitation after brain injury. Some individuals with brain injury may face challenges in all of these areas, while others may experience problems with just a few of them. Regardless, the information in these brochures is crucial to provide those affected by brain injury, as well as the individuals and organizations treating them, with a basic understanding of the complex challenges following brain injury. For additional information about any of the topics covered in The Road to Rehabilitation Series, contact BIA's toll-free Family Helpline at (800) 444-6443 or visit their web site at www.biausa.org.