

Managing Spasticity in Children With Cerebral Palsy Requires a Team Approach

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It's estimated that a half-million children and adults in America have some type of cerebral palsy — a form of brain damage that affects muscle tone and control. Each year, approximately 8,000 infants and 15,000 preschool-age children are diagnosed with cerebral palsy. It's estimated that more than 75 percent of children with cerebral palsy have spasticity or abnormally high muscle tone. Spasticity in a growing child frequently leads to deformities, such as muscle contractures (muscles that are too short) and bone deformities. Which parts of children's bodies are affected by the abnormal muscle tone depends upon where the brain damage occurs.

The three main types of cerebral palsy are spastic, dyskinetic (which includes dystonic and athetoid) and ataxic. A person also might have mixed cerebral palsy (a combination of types). In this article, we'll describe each type of cerebral palsy and its symptoms. The main focus of this article, however, will be the multidisciplinary treatment approach that medical specialists at Gillette Children's Specialty Healthcare use to treat spasticity.

Types of Cerebral Palsy

Spastic

Spastic, the most common type of cerebral palsy, occurs in about 80 percent of children who have cerebral palsy. Spasticity is a motor disorder characterized by a velocity-dependent resistance to movement associated with increased deep tendon reflexes. Depending on which limbs are affected, spastic cerebral palsy is classified as:

- Diplegia (typically both legs)
- Hemiplegia (right arm and leg or left arm and leg)
- Quadriplegia (both arms and both legs)
- Monoplegia (one limb)
- Triplegia (three limbs)

Athetoid

Damage to basal ganglia areas causes athetoid cerebral palsy, which can cause involuntary movements in the face, extremities and trunk. Writhing movements of the fingers are typical of athetosis. The movements often interfere with speaking, feeding, reaching, grasping, standing, walking and other skills requiring coordinated motion.

Ataxic

Children with ataxic cerebral palsy have low muscle tone and poor coordination. This rare form of cerebral palsy affects balance and motion control. Children with ataxic cerebral palsy often walk with an unsteady gait and might take longer than their peers to learn motor tasks.

Dystonic

Dystonia involves fluctuating muscle tone, the tendency to assume postures (such as totally flexed or totally extended), and the preservation of primitive reflexes. Typically, tone increases with heightened emotion or with the effort of attempting to do something.

Mixed

The mixed form of cerebral palsy results from injuries to both the pyramidal and extrapyramidal areas of the brain. Children with mixed cerebral palsy may have the stiff muscle tone of spastic cerebral palsy and the involuntary movements of dystonic cerebral palsy.

Treating Cerebral Palsy

Although there's no cure for cerebral palsy, many of its symptoms can be treated and managed in ways that will improve children's functional abilities. Treatment needs vary widely, depending on the nature and extent of brain damage. Therefore, treating cerebral palsy requires

coordinated care from an interdisciplinary team of health-care professionals, usually including a(n):

- Pediatric rehabilitation medicine physician
- Pediatric neurologist
- Pediatric neurosurgeon
- Pediatrician
- Pediatric orthopaedist
- Physical therapist
- Occupational therapist
- Orthotist
- Speech/language pathologist
- Psychologist and/or social worker
- Nurse

Because children with cerebral palsy experience diverse problems, the treatment team must be diverse as well. Without access to a specialized center offering many disciplines, it's difficult to successfully treat children who have cerebral palsy. At Gillette, our clinical nurses are very involved in treating spasticity. They work with patients and families to ensure that all of their health-care needs are met. The nursing staff screens new patients, coordinates data and appointments, and schedules tests and other evaluations that physicians recommend. Clinical nurses also educate parents on the treatments recommended and help summarize the treatment plan in terms families can understand.

Gillette's Spasticity-Management Team

Note: This section concerns Gillette's spasticity evaluation clinics. Gillette staff from various specialties often recommend spasticity management for children with spasticity. Based on the child's age, type of tone abnormality and level of tone severity, all of these steps may not be necessary.

Children who are candidates for selective dorsal rhizotomy (SDR) surgery or intrathecal baclofen pump implantation are most likely to be seen in a Gillette spasticity evaluation clinic. In addition, the clinic sees patients who require a multidisciplinary evaluation because of issues related to spasticity, orthopaedics or other complex medical needs.

The spasticity evaluation team determines the type and order of treatment interventions for children who have spasticity. A medical specialist — from such areas as pediatric orthopaedics, pediatric rehabilitation medicine, and neurosurgery — typically refers children to the spasticity evaluation clinic. Community physicians also can refer patients to the clinic.

The team approach has become the cornerstone of Gillette's treatment program. That doesn't mean a child needs to see each member of the team at each visit. In fact, some children

won't ever see some members of the team. Rather, it means that each member of the team has unique expertise in treating cerebral palsy and is aware of the specific contributions that other team members offer in solving spasticity problems.

Steps to Evaluation

At Gillette, many children who have spasticity are evaluated in our Center for Gait and Motion Analysis. Here, physical therapists and orthopaedists analyze muscle, joint and nerve problems that affect a child's ability to walk or perform other movements. Computerized motion analysis provides information about the characteristics of the muscle tone problem, any bony deformities that affect children's abilities to move, and, to a degree, how much underlying muscle control children have. A gait analysis is most appropriate for children who walk independently (with or without walking aids) and in whom surgery is an option for treating spasticity. Information from gait analysis can be essential in determining the most appropriate treatment for tone abnormalities in children.

After gait analysis, a physical therapist evaluates each child's passive range of motion, functional skills, strength, and ability to take part in therapy. A portion of the physical-therapy session is videotaped for the team to review later.

Gillette's social workers meet with patients and families to help determine their readiness for treatment and to address their concerns and questions. Social workers also explore resources that may be needed for treatment. If surgery is planned, a social worker discusses the procedure's implications and reinforces the family's long-term commitment to rehabilitative therapy. A child life specialist helps prepare children and families for surgery through educational tours and use of interactive materials.

Finally, a pediatric neurosurgeon, a pediatric rehabilitation medicine physician, and an orthopaedic surgeon jointly evaluate each child. Based on their findings, the findings of the physical therapist and social worker, and the patient's medical history, the doctors recommend treatment.

Many factors affect the choice of treatment. When developing a treatment plan, Gillette's team considers a patient's:

- Type of tone problem
- Level of spasticity
- Physical health and developmental level
- Age
- Cause of spasticity
- Other movement disorders, if any, that affect overall movement
- Underlying strength and control of muscles

- Balance
- Functional abilities
- Tone and its interference with function

The team also considers each family's preferences and needs and looks at how treatment options are likely to affect everyone involved.

Goals of Treatment

Goals of cerebral palsy treatment often include:

- Preventing bone deformities
- Improving mobility
- Maintaining muscle length and range of motion
- Decreasing pain
- Decreasing spasms
- Increasing range of motion
- Improving orthotic fit
- Improving positioning
- Delaying or preventing surgery
- Improving function
- Making it easier to care for someone who is totally dependent

Spasticity alone doesn't necessitate treatment. It should be treated only if the spasticity interferes with a patient's abilities or level of comfort and if treatment is likely to decrease such interference.

Many factors influence treatment decisions, including:

- **Chronicity:** How long spasticity has been present affects treatment goals and intervention choices. Spasticity often, but not always, develops after a brain or spinal-cord injury, and it might not appear immediately.
- **Severity:** Mild spasticity often can be treated successfully with range-of-motion exercises, splints, orthoses and oral medications. Severe spasticity that doesn't respond to conservative management might require more aggressive measures to produce a significant change in function.
- **Distribution:** The distribution of spasticity influences whether to treat a patient focally or globally. It also affects the specific intervention chosen.

Treatment must be tailored to each child's specific problems. Non-surgical treatment may be too conservative if it allows deformities such as bony torsion and/or muscle contractures to progress. Therefore, in some cases, physicians might suggest surgical treatment early on. Alternatively, they may decide on a non-surgical treatment program with — if necessary — surgical treatment later.

Once treatment goals are established, the care team recommends treatment options, such as:

- Physical and occupational therapy
- Speech and language therapy

- Orthoses
- Casting
- Botulinum toxin or phenol injections
- Intrathecal baclofen pump implantation
- Orthopaedic surgery
- SDR surgery
- Oral medications

Physical, Occupational and Speech Therapy

Physical and occupational therapy are the mainstays of treating children with cerebral palsy and other brain injuries. Therapists provide range-of-motion exercises to prevent contractures. The exercises include moving joints to maintain or improve flexibility, stretching to maintain muscle length, strengthening, and performing functional movements. Therapy also helps maximize the impact of other treatments.

Speech/language pathologists assess speech and swallowing problems and work with patients to improve their language and other skills.

Orthoses

Orthoses can help to compensate for weakness and instability. Although they typically don't reduce spasticity, they may help prevent complications of spasticity (such as contractures) or abnormal joint positions. Ankle-foot orthoses have been known to decrease clonus at the ankle as measured by a computerized gait analysis.

Botulinum Toxin and Phenol Injections

Neurolytic blocks (using botulinum toxin or phenol) can focally reduce hypertonicity. The blocks can be used in children of any age. They are rarely used in infants, however, because spasticity usually doesn't cause significant functional problems until children reach at least 1 year of age. The blocks often control spasticity and its complications until more aggressive treatments are appropriate. The blocks can be used indefinitely if continued functional improvements are seen.

Botulinum toxin blocks the release of acetylcholine at the distal axon, paralyzing muscles and therefore decreasing tone. In addition, botulinum toxin blocks neurotransmission of the alpha and gamma motor neurons to the muscle spindle. The medication weakens extrafusal muscles and eases spasticity by decreasing the excitability of the muscle spindle. Although the Food and Drug Administration (FDA) hasn't approved the use of botulinum toxin for spasticity, it's well-accepted and supported by the American Academy of Cerebral Palsy and Developmental Medicine and the American Academy of Physical Medicine and Rehabilitation for use in children with spasticity.

Physicians have used phenol blocks with good success for decades. During the procedure, physicians use needle electrostimulation to locate motor nerves in spastic muscles, then inject aqueous phenol solution. Because children don't always tolerate the procedure well, general anesthesia is sometimes used. The most common side effect of the use of phenol in children is dysesthesias.

Oral Medications

Oral medications are a systemic, rather than focal, treatment for spasticity in children. Oral medications commonly used in children are baclofen, diazepam, dantrolene and tizanidine.

Surgery

■ Intrathecal Baclofen Pump Implantation

Another treatment to ease spasticity, primarily in the trunk and lower extremities, is the intrathecal baclofen pump. When baclofen is delivered intrathecally by a catheter attached to a subcutaneously implanted computerized pump, spasticity can be markedly reduced. An intrathecal baclofen pump isn't permanent — if clinical effects don't include improved function or comfort, the pump can be removed without residual effects. The pump needs refilling every one to three months and replacing when the battery loses power (usually after five to seven years).

Intrathetically delivered baclofen also can reduce tone in children with mixed spasticity and dystonia, although the FDA has only approved its use for spasticity. This is especially advantageous for children with quadriplegia, who have few other treatment options. Because the pumps are computerized, dosages can be regulated using radio-transmitted signals from a laptop computer — optimizing the amount of spasticity reduction.

■ Orthopaedic Surgery

Orthopaedic surgery isn't an option for managing spasticity. Instead, it's used to help correct the secondary problems that occur with growth in the face of spastic muscles and poor motion control. Those problems include muscle contractures and bony deformities.

Children with cerebral palsy, for example, often can't run and play with sufficient movement to adequately stretch their muscles, particularly when those muscles are spastic. This is a serious concern because stretch is the stimulus that tells a muscle to grow.

Muscles move joints by pulling on the bones. Because of the uneven/abnormal muscle forces present during growth in a child with cerebral palsy, the growing bones often become plastically deformed or twisted. This is particularly true of the femur (femoral anteversion) and the tibia (tibial

torsion). When such situations occur, muscles can't move the joint in a normal manner. The feet also frequently become deformed, which makes walking difficult. We refer to these bony deformities as *lever-arm dysfunction* because bones are the levers upon which muscles work. Fortunately, lever-arm dysfunction can easily be corrected with appropriate orthopaedic surgery.

When SDR surgery or intrathecal baclofen relaxes muscles and reduces spasticity, movement becomes easier and muscles can grow more readily. Orthopaedic surgery can then lengthen muscles with residual deformity. It can also correct long-bone torsions (femoral anteversion and/or tibial torsion) and foot deformities, maximizing the child's ability to walk.

■ SDR Surgery

SDR surgery reduces spasticity, primarily in the trunk and legs. Surgeons identify dorsal or sensory roots at the L1 to S1 or S2 levels, then divide them into rootlets. The rootlets are then stimulated, and the resulting motor or reflex responses are monitored by electromyography and on clinical exam. If an abnormal response is seen, the rootlet is cut. The percentage of rootlets cut varies among patients, depending on their response to stimulation, but typically it's between 25 and 45 percent.

Following an SDR, spasticity decreases significantly. Patients who have been using their tone to assist with functional activities usually appear to be weaker. Because of the marked change in tone following an SDR, there's an opportunity to change a patient's motor patterns. Doing so requires aggressive daily physical therapy and occupational therapy for several weeks. The intensity of therapy slowly tapers over subsequent months. Patients must be able to take part in the intense therapy necessary to a successful SDR.

Because one of the main purposes of an SDR is to change motor patterns, however, patients must be young enough that a significant amount of brain plasticity exists. Therefore, the ideal age range for an SDR is 4 to 8 years, although patients up to adolescence can be appropriately treated with an SDR. Patients who undergo this surgical procedure typically stay in the hospital for six weeks while taking part in intensive rehabilitation therapy.

Facts About Cerebral Palsy

Symptoms of Cerebral Palsy

Symptoms of cerebral palsy differ widely, depending upon where and to what extent the brain was injured. Some children might be completely disabled; others might display few, if any, effects. Common symptoms of cerebral palsy and associated problems include:

- Difficulty walking or an inability to walk
- Difficulty using or an inability to use arms and/or hands
- Difficulty speaking and swallowing
- Bladder and bowel control difficulties
- Breathing, vision and hearing problems
- Seizures
- Learning disabilities
- Behavioral and/or attention-deficit disorders
- An impaired sense of touch and/or pain

Early signs of cerebral palsy usually appear before 3 years of age. Infants with cerebral palsy are frequently slow to reach developmental milestones, such as rolling over, sitting, crawling, smiling or walking.

Etiology of Cerebral Palsy

Lack of oxygen to the brain can cause brain cells to die, resulting in cerebral palsy. Problems with the placenta or umbilical cord can block oxygen to the brain, as can a ruptured uterus or a maternal stroke caused by toxemia.

Bleeding in the brain and a stroke in utero also can cause cerebral palsy. Because the autoregulation of the blood supply to the brain is impaired, premature infants are prone to watershed injuries. Cerebral palsy also can result from infections (including herpes, cytomegalovirus or group B strep) acquired while passing through the birth canal.

Diagnosing Cerebral Palsy

Many developmental milestones — such as reaching for toys (at 3 to 4 months), sitting (at 6 to 7 months) and walking (at 10 to 14 months) — are based on motor function. Suspect cerebral palsy in children whose development of these skills is delayed. In diagnosing cerebral palsy, consider the extent of any developmental delays and the existence of physical findings, such as abnormal muscle tone, abnormal movements, abnormal reflexes, and persistent infantile reflexes.

It often takes time for specific motor problems — and a definitive diagnosis of cerebral palsy — to appear. Most children with cerebral palsy can be diagnosed by the age of 18 months. Physicians who suspect cerebral palsy should recommend magnetic resonance imaging (MRI) and computed tomography (CT) scans to exclude other neurologic diseases, such as hydrocephalus.

Differential Diagnosis

Children who have various types of disabilities sometimes exhibit symptoms similar to those of cerebral palsy. For example, children with spinal-cord dysfunction — resulting from a spinal-cord injury, a congenital malformation or spina bifida — can experience weakness, abnormal muscle tone, bowel problems and bladder dysfunction, just as children with cerebral palsy can. Children with temporary motor problems resulting from brain injuries, seizures, drug overdoses, and some brain tumors might also show symptoms that mimic cerebral palsy.

Disorders that primarily affect muscles, nerves and bones — rather than the brain — aren't considered cerebral palsy. Such conditions include muscular dystrophy, Charcot-Marie-Tooth disease and osteogenesis imperfecta.

Now Open!

On June 21, Gillette opened the Burnsville Clinic — our fifth outpatient site — on the Fairview Ridges Hospital campus (305 E. Nicollet Blvd.). At 12,500 square feet, the site houses our second-largest outpatient clinic and a therapy center focusing on children and teens who have cerebral palsy and other chronic or disabling conditions.

Gillette's interdisciplinary teams include physicians, nurses, therapists, social workers, psychologists, child life specialists, certified orthotists and seating specialists, and other specialists. The Burnsville Clinic offers many of Gillette's key medical specialties, including consultations and services in:

- Craniofacial surgery
- Pediatric neurology
- Pediatric neurosurgery
- Pediatric orthopaedics
- Pediatric rehabilitation medicine

Our services include:

- Occupational, physical, and speech and language therapy
- Spasticity evaluations
- Customized assistive equipment, including orthoses, wheelchair modifications and augmentative communication devices
- Seating evaluations
- Traditional and computerized X-rays
- Casting
- Psychology, social work and child life services

The new clinic was designed for maximum "kid comfort." Its innovative interior portrays a nature theme, with murals and construction materials depicting water, trees, prairies and forests.

To Refer a Child

Physicians, therapists, parents and others may refer patients to Gillette's Burnsville Clinic by calling 952-223-3400 or 651-229-3944. To learn more about Gillette, visit our Web site at www.gillettechildrens.org.

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- Admitting 651-229-3944
- Center for Cerebral Palsy 651-290-8712
- Center for Craniofacial Services 651-229-1716
- Center for Pediatric Orthopaedics 651-229-1758
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