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The Importance of Strengthening

[Rehab Management - January 2010](#)

by Richard Koscielny, PT

Strength training is important for everyone, including children with cerebral palsy.

The concept of strength development for cerebral palsy (CP) has recently become very popular. The idea of intensive therapy to treat patients with CP is supported by research. However, many professionals suffer from a lack of basic knowledge about strengthening physiology, strength training, adaptation to exercises, etc. Therapists and fitness and wellness instructors are often not sure how to proceed, and they end up modifying adult versions of strength training programs and applying them to children. Many professionals misinterpret pediatric strength training as a weight lifting, power lifting, and body building therapy program.



Izabela Koscielny, PT, assists a young patient with her strengthening routine.

To understand the role of strength in intensive therapy, one needs to understand that strength is the most important element of life. All human movement—from the blinking of an eye to walking and running—depends on strength and proper functioning of skeletal muscle. Each basic activity is based on strength. It is impossible to develop endurance, speed, agility, balance or coordination without it.

Research confirms that children with CP respond to external stimuli such as strengthening exercises the same way (neurologically and morphologically) as non-disabled individuals. These findings allow therapists to use knowledge from sport medicine and exercise physiology to develop a new and effective therapy program.

Strength is very important for patients with neuromotor disorders. It helps not only to initiate movement, but also to control or inhibit it. Some benefits of strength include:

- Increases postural muscle tone;
- Decreases spasticity;
- Helps prevent contractures/deformities;
- Improves trunk stabilization and control;

- Improves fine and gross motor skills;
- Improves balance, coordination, and movement control;
- Improves endurance; and
- Decreases involuntary movements.

By definition, "Strength is the ability of the neuromuscular system to produce force against an external resistance." There are many different categories of strength. When working with CP children, we found that the most important are:

- General strength;
- Strength of the muscular system—it is the foundation of the intensive therapy program;
- Muscular endurance;
- The ability of the neuromuscular system to produce force in a repetitive motion over extended periods of time;
- Specific strength; and
- Strength related to motor patterns.

Development of Strength

The physiological adaptation to a strength-training protocol:

I. Neurological

- Increased muscle activation (EMG)
- Reduced co-activation of antagonist muscles
- Greater activation of synergist muscles
- Spinal cord connections
- Increased motor unit synchronization
- Cross education
- Bilateral effect

It has been suggested that the development of strength in the early phase of training is mainly affected by neurological factors, whereas in the longer-term training, adaptations are limited by morphological factors. The time when neurological factor adaptation predominates is within the first weeks from the initiation of the resistance training regime depending on the type of exercise and the structure of the resistance training program. The neural phase serves as a time to learn, optimize, and control movement. Neural changes continue with training, helping to achieve movement. This phase is more beneficial for CP than the hypertrophy phase. Once the neurological "learning" phase begins to diminish, remodeling of the muscle is beginning to take place and strength gains continue.

II. Morphological

- Muscle hypertrophy
- Muscle fiber type transitions
- Alternations to muscle architecture

Hypertrophy is the increase in muscle size as a result of an increase in either the number of muscle fibers in a group (hyperplasia), or the size of individual muscle fibers (hypertrophy). Research confirms hypertrophic changes in muscles of CP patients.

Currently, six muscle fibers have been identified. They are generalized into three categories: Slow-twitch or Type I oxidative fibers, intermediate or Type IIa fast-twitch oxidative-glycolytic fibers, and fast-twitch or Type IIb glycolytic fibers. Children with CP generally lead a very sedentary lifestyle. The muscles undergo structural changes related to their lack of activity. Type I muscle fibers change their structure to Type II. The result is most prominent in large groups of postural muscles. Children with CP need Type I fibers to control posture and stabilize the body to perform daily functions.

Current studies show that proper training can induce fiber-type alternation. Fast-twitch fibers might become more oxidative with training.

Treatment Protocol

To prepare an effective intensive therapy program, we face many challenges related to the patient's medical condition. We have to keep in mind that we work with the special needs population. It requires us to take many facts under consideration:

- Severity of central nervous system damage
- Spasticity and/or low tone of the muscles
- Pathological reflexes
- Contractures and deformities
- Cognitive and functional level
- Motivation
- Medical history

In designing the treatment program, we cannot forget the basic training principles: specificity and overload.

The first principle is very important to design treatment properly. Specific exercises produce specific adaptation, generating a specific training effect. The second principle message is to provide enough stress to elicit positive physiological changes.

Sport and fitness instructors use many different methods and forms of resistance training we can choose from, including:

- Static-action resistance training

- Plyometric
- Eccentric
- Isometric
- Free weights
- Body weights
- Electrical stimulation

After choosing the proper method and form of strength training, our next step is to set time, loads, sets, repetitions, intensity, position, technical difficulty, and rest. Manipulation of these variables allows us to individualize the treatment and modify it according to changes in the patient's status, keeping in mind the principles of training.

A very important issue is the amount of resistance. My goal is to achieve muscle strength necessary to control the body and work against gravity. It is very useful to use the body parts weight formula.

Another important variable is the number of repetitions. The most commonly used formula is 10 repetitions. This formula works only for general and maximum strength. It helps to develop Type IIb muscle fibers. However, we also need endurance and specific strength (Type I and IIa). Those types of strength require more repetitions, 10 to 15 for strength/endurance, 15 to 25 for endurance.

Based on the principles presented above, we created a treatment program that has proven to be very effective. Children who participate in therapy at the Pediatric Fitness Center sign up for 3 to 4 weeks of intensive sessions, 3 hours a day, 5 days a week. They work individually with the same therapist. Each time program is tailored to the child's specific needs and abilities with the major goal being strength and functional skills. Our therapy protocol includes a variety of exercises: stretching, balance, strengthening, functional activities, muscle reeducation, vibration therapy, and electro-stimulation. At the end of each session, the parents are provided with a home exercise program, which includes pictures of the recommended exercises, exercise protocols, and the necessary equipment.

Unique Equipment

The treatment approach used in our facility utilizes primarily two unique tools: a universal exercise unit and a soft, dynamic proprioceptive orthotic "suit," which are used to develop an individualized and effective treatment program.

The universal exercise unit is a versatile tool consisting of a system of pulleys, straps, and splints that is used during all stages of therapy with a variety of patients. It serves as a pulley and suspension system. The pulley system enables one to isolate the desired muscle group and work on specific movement or function. It also helps to reeducate the patient's nervous system, by isolating one extremity from the others, and moving it independently.

While strengthening muscles and improving function, the system of exercises performed in the unit contributes to range of motion, both active and passive, and improved muscle flexibility and tone. The other function of this unit is as a dynamic suspension system. The goals

of the exercises performed are to improve functional skills, balance, coordination, strength, and sensory-motor integration. The exercise unit can also be extremely helpful while working on specific goals like endurance strength or a certain skill.

The orthotic suit is a modification of a space suit designed by Russian scientists in the 1970s that restored posture and supported weakened muscles in space in order to prevent atrophy and osteoporosis in astronauts. The suit was later modified for patients with neurological and motor-developmental disorders. It is used in our practice to provide dynamic correction, enabling movement or postural error to occur, while it simultaneously facilitates the correct position or movement, providing external stabilization to the trunk, and therefore allowing more fluent and coordinated movement for both upper and lower extremities. The soft, dynamic proprioceptive orthotic is used to treat patients diagnosed with CP, stroke, ataxia, athetosis, developmental delay, traumatic brain injuries, spina bifida, spinal cord injuries, and many other neurological disorders. It is a tremendous help to patients suffering from sensory disintegration.

Patients in our clinic also use fitness equipment similar to that found in gyms like a leg press, rowing machine, and stationary bike. We plan to add an additional therapy room with interactive video games.

Conclusion

The strengthening method utilized at our clinic can be used in a variety of therapy settings including hospitals and clinics; and can be applied for treatment of children and adults with a wide range of neuromotor disorders. It serves well as a stand-alone treatment, or can be combined with existing programs. The positive results of the strengthening approach are convincing more insurance companies to cover this treatment method. Our facility is primarily cash based; however, we were evaluated by insurance case managers. They found the program so effective that they agreed to cover some of the patients' therapy at 100% a few times a year.

I strongly believe that strengthening serves as an irreplaceable element of therapy for patients with CP and should be used in every physical therapy facility.

Richard Koscielny, PT, and his wife, Izabela Koscielny, PT, are the owners of Pediatric Fitness Center, Keego Harbor, Mich. For more information about their clinic, go to www.cpfitnesscenter.com.

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A Personal Motivation

I remember 18 years ago when our daughter, Kaya, was born. We were told she would never walk; she was born 3 months premature. She was diagnosed with spastic quadriplegia cerebral palsy (CP).

My wife and I are both PTs with a strong athletic background. Using our knowledge and experience, we created a program for our daughter based on exercise physiology, sport medicine, and neurology. We added strengthening exercises and created a method that resembles the training of athletes rather than a typical physical therapy session.

Now, Kaya is a senior in high school and she is able to walk independently. In addition, she participates in walk/race events. As parents, we are happy and proud of her progress. Professionally, we achieved great success in creating a unique intensive therapy approach. Since 2002, we have trained thousands of therapists and helped create hundreds of intensive therapy centers in the United States, as well as several countries around the world. We have implemented our strengthening methods in many children's hospitals, United Cerebral Palsy centers, and other private therapy clinics.

During our physical therapy career, my wife and I have had the opportunity to teach students and treat hundreds of CP patients. In this article, I will provide an overview of strength training and the physiological facts related to strength development for individuals with CP. Also, I will briefly describe the intensive therapy method and equipment that are used in our facility.

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