

# ELECTRICAL STIMULATION AS A PHYSICAL THERAPY TREATMENT MODALITY FOR CHILDREN

Information for Parents of Children with Developmental Diagnoses including Cerebral Palsy, Down Syndrome, Hypotonia, Toe Walking, and Developmental Delay

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*Years of scientific research has shown that the best way for children with developmental diagnoses to achieve and maintain optimal health across all body systems (musculoskeletal, neuromuscular, cardiopulmonary) is to help them engage in age-appropriate play and functional tasks. Pediatric physical therapists work with families to help their children reach their maximum potential in these areas.*

One well documented therapeutic modality to achieve these goals is electrical stimulation.<sup>1,2</sup> This article will describe this modality and explain how it can be useful for the pediatric population.

## WHAT IS THERAPEUTIC ELECTRICAL STIMULATION?

Electrical stimulation (ES) is the application of electrical impulses with sufficient intensity to elicit a muscle contraction during an

exercise program. It can be applied either percutaneously (needles placed through the tissue) or transcutaneously (electrodes placed on top of the skin). This article will only address the transcutaneous application of electrotherapy. Electrodes of different shapes and sizes are applied to the muscles, which are then connected to wires and a control unit. Specific parameters are used for children to keep it comfortable for them. Electrical stimulation has many applications, but this article will discuss the practical applications of only neuromuscular electrical stimulation (NMES) and functional electrical stimulation (FES).

## WHAT IS NMES AND FES?

When NMES is used, the unit is set to cycle to elicit muscle contraction, and then relaxation for a set period of time, as determined by the therapist. For this intervention, the child can be in any position, resting or moving. When FES is used, the unit only turns on to elicit muscle contraction when it is triggered by the therapist with a remote control, while the child is performing a functional task (like walking). This intervention is used to train a muscle to activate at a specific time during the functional task.



**PART OF THE PROTOCOL:** The best way for children with developmental diagnoses to achieve and maintain optimal health across all body systems is to help them engage in age-appropriate play and functional tasks. Electrical stimulation is a treatment modality that has well documented support as an intervention that produces good functional results when used in conjunction with functional task training, and when carried over in a home program.

## HOW HAS THIS THERAPY BEEN MODIFIED FOR THE PEDIATRIC POPULATION?

Traditionally, clinicians have used adult protocols with their pediatric patients. These protocols do not take the developing system into account, and are often poorly tolerated by the child, leading to poor compliance. The approach described in this article is based on decades of work by various clinicians and researchers, and has been recently modified and taught by Dr. Susan Hastings, a renowned pediatric physical therapist. The differences in this approach relate to which muscles are targeted and the parameters that are used.

## IS ELECTRICAL STIMULATION SAFE FOR CHILDREN?

ES is safe for most children and can be started as early as when a diagnosis is received. Age should not limit the use of e-stim, and in fact, there have been studies conducted using ES for children younger than 24 months.<sup>3-5</sup> There is a significant amount of research supporting this modality's efficacy and safety for children while using adult tested parameters, although there are reports of discomfort/pain. The parameters described in this paper are lower and specific for the pediatric system eliminating pain and discomfort as the side effect. Possible side effects may include dis-

comfort from the stimulation, however pediatric parameters are well tolerated. Discomfort from removing electrodes is similar to removing a Band-Aid. If the modality is used by an untrained practitioner or untrained parent there is risk of skin burn or fatigue to the muscle. However, a trained practitioner will understand precautions, contraindications and appropriate application. There are a number of contraindications/precautions beyond the scope of the article, but this is true for all therapeutic modalities. A trained practitioner should only opt to use this modality when it is appropriate for the patient. Medical clearance should be obtained for children with complex medical diagnoses, including: seizure disorders, shunts, or cardiac issues. ES can also help children who have received BOTOX and orthopedic procedures.

## WHO CAN PROVIDE THIS INTERVENTION FOR MY CHILD?

Use of NMES and FES is within the scope of practice for physical therapists and no additional certification is needed. We do recommend that clinicians take continuing education courses to learn about pediatric settings. Occupational therapists are required to take a specified number of continuing education credits to train in the use of electrical stimulation prior to being allowed to use this modality.

## WHAT IS THE COST OF THIS INTERVENTION? IS IT COVERED BY INSURANCE?

If a family is purchasing an e-stim unit for a home exercise program, the cost is between \$350 and \$425 and is typically not covered by insurance. The cost of therapeutic services using this modality will vary and insurance coverage will depend if the clinician is an in-network or out of network provider. Clinicians will use their units and use patient specific electrodes.

## HOW DOES ELECTRICAL STIMULATION WORK?

Therapeutic electrical stimulation to a skeletal muscle can initiate an artificial physiological response by stimulating the nerves and influencing the connections to the brain and spinal cord. When this intervention is applied over time, it can improve motor function by reducing hypertonicity (high muscle tone), increasing muscle strength and muscle bulk, and improving gait (quality of walking). Principles of motor learning are used when using the FES, as described in this article. Motor learning is how the nervous system reorganizes itself to improve motor function through repeated practice of a functional task, leading to improved motor skill performance. The repetitive therapeutic electrical muscle stimulation facilitates motor learning when





provided at the same time as the functional task that is being practiced.<sup>3,6</sup>

## WHAT DOES THE RESEARCH SAY ABOUT ELECTRICAL STIMULATION?

The benefits of NMES and FES have been well documented in the literature across multiple patient populations, across the lifespan.<sup>6</sup> Recent studies have shown that ES promotes neural recovery in individuals with an impaired nervous system, something which was thought not possible.<sup>7</sup> It also facilitates neuroplasticity (brain to form new connections) due to the frequent input.<sup>8</sup> Multiple published studies have enumerated the various benefits of ES for children. It improves muscle

**"A study found that children who received functional electrical stimulation during walking together with traditional treatment, underwent an average of 4.5 fewer surgical procedures than children who just received traditional therapy."**

bulk and strength, reduces muscle tone (hypertonicity), improves passive and active range of motion, and it improves walking speed and foot and ankle mechanics during walking.<sup>2,3,7,9-12</sup> Many studies found that ES can lead to significant positive changes in walking in children with cerebral palsy.<sup>11</sup> The use of ES has evolved from stimulating a pair of muscles to multiple muscles groups, with FES units during walking.<sup>13</sup> Numerous studies have noted an improvement in upper extremity function in children with cerebral palsy, due to improved muscle length, reduction in tone and improved muscle strength.<sup>2,9,14,15</sup> A study found that children who received FES during walking together with traditional treatment, underwent an average of 4.5 fewer surgical procedures than children who just received traditional therapy.<sup>10</sup>

## HOW CAN ELECTRICAL STIMULATION HELP MY CHILD?

Here are some clinical examples describing how this therapeutic modality may help your child.

**Hypotonia (low muscle tone):** Hypotonia can be of central (Down's syndrome) or peripheral origin (spinal muscular atrophy).<sup>17</sup> This article does not discuss ES application for hypotonia in progressive, degenerative conditions like spinal muscular atrophy. Children with hypotonia typically present with poor posture, like a slouched back, a protruding tummy, and flat feet, and they present with decreased general strength, and activity tolerance.<sup>18</sup> For these children, NMES can be used on the back and core muscles to help them assume and maintain an upright posture.<sup>19,20</sup> NMES or FES can also be used by placing electrodes on the child's feet to help strengthen the small muscles in the foot, for improving walking and balance skills.

**Hypertonicity (high muscle tone):** ES is very important for hypertonic muscles, because it can help the muscles "reset" and decrease their tone, learn how to turn on and off, and develop true strength for functional movement. There are multiple applications for this in cerebral palsy, based on your child's gross motor func-

tion classification system (GMFCS) level of function. There are five levels within this classification system based on the motor skills attained by the child. Level 5 is the lowest functioning, where the child is bed or wheelchair bound and needs assistance for all activities. Level 1 is the highest functioning, and children in this level can walk, run, jump and go up and down stairs independently.

Levels 4-5: ES can be provided to reduce the hypertonicity in the muscles to help families perform hygiene tasks (like a diaper change, or bathing), to improve posture (in wheelchairs, standers, and gait trainers) and to assist with breathing (if it is used on the core muscles).<sup>19,20</sup>

Level 1-3: ES can be used to help a child develop the subskills which improve quality of movement for transitioning between positions from the floor to bed/chair/stand, for a controlled standing position, and to develop coordinated and energy efficient walking. To achieve these goals, a therapist may choose to apply e-stim to certain muscles of the legs, feet, and/or the torso. ES can also be used to help children gain the strength and control for higher level motor skills, like: fast walking, running and jumping.

**Idiopathic Toe Walking:** Children who walk on their toes benefit from e-stim to help them place their feet flat on the ground, realign their posture, and improve postural awareness for safe and energy efficient walking, as developed and taught by Dr. Hastings.<sup>21</sup>

## HOW OFTEN SHOULD ELECTRICAL STIMULATION BE USED?

What is the dosage? Based on clinical experience, ES protocols are most successful when used 4-5 times a week (clinic and home program combined). Families are encouraged to use e-stim as part of a home exercise program, in between therapy sessions. The specific dosage and the number of muscles targeted will vary and be determined by the therapist, based on the child's level of function and the goal being worked on.

## WHEN CAN I EXPECT TO NOTICE CHANGES IN MY CHILD'S MOTOR FUNCTION?

Changes in performance vary depending on the goals set for the child, as per their level of function. Changes like reduction in tone, improved posture, and improved components of balance can be seen within weeks. However, it takes up to 6 months of practice for a child to learn a new functional movement pattern and for that pattern to become permanent (indicates motor learning has taken place) as shown by multiple researchers. Factors like growth spurts and illness can impact change, as well. Additionally, carryover of the therapeutic benefits throughout the day at home and at school is important, and recommendations for compressive garments and foot orthoses are often made to assist with this. Overall, it is important to stay consistent with the treatment protocol and plan set by the therapist.

## WHAT MACHINES CAN BE FOR THERAPY WITH ELECTRICAL STIMULATION?

It is good to use an electrical therapy unit that allows the therapist and family to select from a wide range of parameters for the individually designed treatment protocol. There are units that have remotes (hand held trigger) for the FES protocols. Safety features, such as an automatic lock to prevent the child from making adjustments and to stop if any components were to get loose, are a great

benefit too. It should be small and portable for training of walking or other mobility skills. The devices used are FDA approved and are categorized as class II medical devices.

## SUMMARY

While multiple treatment strategies for pediatric patients have been developed, the general consensus is that no one strategy alone works the best. When selecting a treatment protocol, one should bear in mind the long-term benefits that can be attained, like a safe and steady walk, prevention of pain and deformities, and importantly, the ease with which a home program can be done. E-stim is a treatment modality that has well documented support as an intervention that produces good functional results when used in conjunction with functional task training, and when carried over in a home program. •

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## NOVEMBER IS EPILEPSY AWARENESS MONTH

## Seizure First Aid

How to help someone having a seizure

1

**STAY** with the person until they are awake and alert after the seizure.

- ✓ Time the seizure
- ✓ Remain calm
- ✓ Check for medical ID

2

Keep the person **SAFE**.

- ✓ Move or guide away from harm

3

Turn the person onto their **SIDE** if they are not awake and aware.

- ✓ Keep airway clear
- ✓ Loosen tight clothes around neck
- ✓ Put something small and soft under the head

Call 911 if...

- Seizure lasts longer than 5 minutes
- Person does not return to their usual state
- Person is injured, pregnant, or sick
- Repeated seizures
- First time seizure
- Difficulty breathing
- Seizure occurs in water

Learn more: [epilepsy.com/firstaid](http://epilepsy.com/firstaid)

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