



## Description of the PediaSuit Protocol™

### *Descrição do Protocolo PediaSuit™*

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### Abstract

**Introduction:** PediaSuit Protocol™ is an intensive therapy with a holistic approach to the treatment of individuals with neurological disorders like cerebral palsy (CP), developmental delays, traumatic brain injuries, autism and other conditions which affect a child's motor and/or cognitive functions. **Objective:** The aim of the present work is to describe the PediaSuit Protocol™. **Methods:** The authors team remained two months observing the care provided in a clinic with physical therapists trained by the PediaSuit Protocol™ team (USA). **Results:** The PediaSuit™ is a therapeutic protocol which uses a suit combined with intensive physical therapy and consists of up to four hours of therapy a day, five days a week, during three or four weeks. The PediaSuit Protocol™ is customized to fit the needs of each child, with specific functional goals, and usually involves an intensive rehabilitation program. It combines the best elements of various techniques and methods, and has a sound rationale based on exercise physiology. **Conclusion:** This protocol anticipates results obtained only with long periods of conventional physical therapy.

**Keywords:** PediaSuit Protocol™. Intensive physical therapy. Cerebral palsy.

## Resumo

**Introdução:** O Protocolo PediaSuit™ é uma terapia intensiva com uma abordagem holística para o tratamento de indivíduos com distúrbios neurológicos, como paralisia cerebral (PC), atrasos de desenvolvimento, lesões cerebrais traumáticas, autismo e outras condições que afetam as funções motoras e/ou cognitivas de uma criança.

**Objetivo:** O objetivo do presente trabalho foi descrever o Protocolo PediaSuit™. **Métodos:** A equipe de autores permaneceu dois meses observando os cuidados prestados em uma clínica com fisioterapeutas treinados pela equipe PediaSuit Protocol™ (EUA). **Resultados:** O PediaSuit™ é um protocolo terapêutico que utiliza um traje especial combinado com a terapia física intensiva, com duração de até quatro horas por dia, cinco dias por semana, durante três ou quatro semanas. O Protocolo PediaSuit™ é personalizado para atender às necessidades de cada criança, com objetivos específicos, e, geralmente, envolve um programa intensivo de reabilitação. Ele combina os melhores elementos de várias técnicas e métodos e tem bons fundamentos com base na fisiologia do exercício. **Conclusão:** Esse protocolo antecipa resultados obtidos somente com longos períodos de fisioterapia tradicional.

**Palavras-chave:** Protocolo PediaSuit™. Fisioterapia intensiva. Paralisia cerebral.

## Introduction

PediaSuit Protocol™ therapy has been proposed as an alternative to conventional physiotherapy and is based on a suit originally designed by the Russians ("Penguin" suit), in the late 1960s, to be used by cosmonauts in space, to minimize the effects and to maintain neuromuscular fitness of weightlessness (1-3).

Suit therapy, or dynamic proprioceptive correction (1), has been popularized as a treatment modality in Poland and in the United States, and is focused on improving sensory stimulation and providing patients with the ability to stand and move through suit therapy resistance. This method allows a person to learn movement, standing posture and balance strategies (3).

PediaSuit Protocol™ is an intensive therapy with a holistic approach to the treatment of individuals with neurological disorders like cerebral palsy (CP), developmental delays, traumatic brain injuries, autism and other conditions which affect a child's motor and/or cognitive functions. According to the literature (2, 4, 5), the intensive therapy results in a significantly improved skills acquisition when compared with conventional amounts of physiotherapy and it can generally accelerate the acquisition of motor abilities in children with CP, for example.

The key element in an intensive therapy is a strengthening and balance program established for the participant based on his/her individual needs, strengths and weaknesses (6). Increased strength

is reflected in daily functional activities that usually follow or are combined with strengthening exercises. Elimination of pathological reflexes (1) and establishing new, accurate, and functional patterns of movements is of significant importance (7).

A typical day of a intensive generic program may consist of warming up and deep tissue massage, tone reduction and sensory integration techniques, decreasing pathological movement patterns, increasing active proper movement patterns, stretching/strengthening specific muscle groups responsible for functional movement, progressive resistance exercise, balance/coordination and endurance training, and transferring of functional activities and gait training (2, 4, 5). The intensive therapy is ideal for those looking to accelerate their progress in developmental and functional skills (8).

According to Report Executive Committee, "Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitations that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behavior; by epilepsy, and by secondary musculoskeletal problems" (9).

There is no standard therapy that works for all patients (e.g., CP) and they need different kinds of therapy to overcome their impairments (10). Treatment for CP focuses on how to help the child maximize his or her

potential (5). The treatment plan may include physical therapy, which helps to develop the strength of muscles, as well as, improve or develop skills to enhance their independence in motor skills such as walking, sitting, self-care, play and maintaining balance (1, 2, 5, 11).

The intervention plan may also include occupational therapy, which helps to develop fine motor skills such as dressing, feeding, writing, and other daily living tasks. These therapies are focused on decreasing the degree of impairment (e.g., muscle spasticity) and increasing participation in activities of daily living (9). Speech therapy may help patients to develop communication skills focusing in particular on speaking, which may be difficult due to problems with muscle tone of the tongue and throat (6, 12). Still others may need surgery, drug therapy (e.g., to control seizures and muscle spasms) and/or mechanical aids that are tailored to the unique needs and impairments of each patient (13). Considering we are presenting a new intensive therapy treatment, the aim of this present work was to describe the PediaSuit Protocol™.

## Methods

One of the authors of this study was part of the PediaSuit Protocol™ therapy developer team. In this sense, the description shown may be understood as a normative document for the standardization of the protocol. Other authors contributed in the detailed organization and systematization description of the protocol. To this end, the authors team remained from 1<sup>st</sup> September to 30<sup>th</sup> October, 2011 observing the care provided in a clinic with physical therapists trained by PediaSuit Protocol™ team (USA). In addition, print and online materials provided by the clinic that developed the PediaSuit Protocol™ were used and a search was conducted by the descriptor “PediaSuit”, in March 2012, in Scopus, ISI Web of Knowledge<sup>SM</sup>, Pubmed, Medline, SciELO and Google scholar databases. In the search performed no paper was found, except one case study involving the PediaSuit Protocol™ developed by researchers from Curitiba, Paraná - Brazil (14), where the authors described only the neuromotor changes over 30 days of treatment.

Aiming for a good protocol understanding, the results were organized in the following topics: protocol general considerations, equipment used, and phases of the protocol.

## Protocol general considerations

The PediaSuit Protocol™ therapy method combines the best elements of proven various techniques (6, 12, 15-18) and methods (1-3, 5), and has a sound rationale based on the exercise physiology. The documented history of the PediaSuit Protocol™ supports its use for individuals with debilitating muscular disorders and degenerative muscular complications.

The PediaSuit Protocol™ therapy is the use of a suit combined with intensive physical therapy and consists of up to four hours of therapy a day, five days a week, for three or four weeks. The PediaSuit Protocol™ is composed by four steps: warm up and stretching, suit, “monkey cage” and “spider cage”.

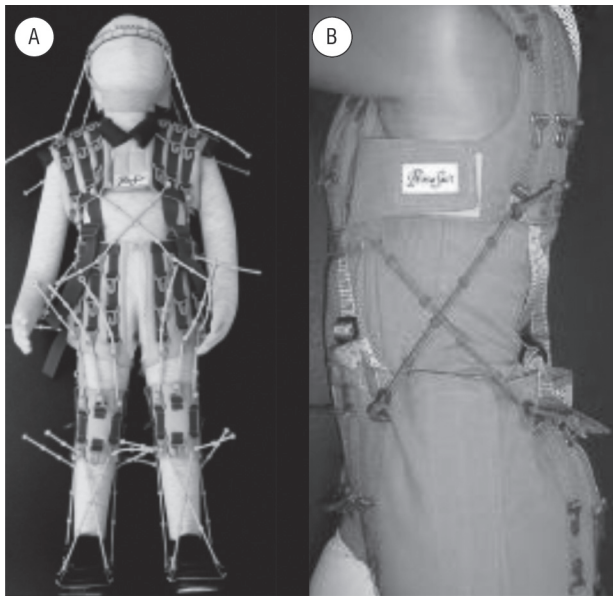
## Equipments

### Suit

The suit consists of a vest, shorts, knee pads and specially adapted shoes with hooks and elastic cords that help tell the body how it is supposed to move in space (Figure 1). Therapists use the suit to hold the body in proper physical alignment. During specialized exercises, the therapists adjust the elastic connectors that topographically mirror flexor and extensor muscles, trunk rotators and the lower limbs. Additional attachments correcting the position of feet, head and other areas of the body have also been designed. The suit serves as a stability vest that produces a vertically directed load of approximately 15 to 40 kg.

### Ability Exercise Unit

Not only is the ability exercise unit (Figure 2) the most effective device for improving muscle strength, it also allows isolation of the desired muscle group. What this means is that whenever a person with a neurological disorder is asked to perform a certain movement, due to muscle tone and lack of coordination, strength and balance, he/she will try to perform that movement with both extremities (upper and lower) at the same time. The ability exercise unit, along with specific exercises performed in it, allows one to re-educate the patient’s nervous system to isolate one extremity from the other and move it independently.



**Figure 1** - Suit with its parts: shorts, knee pads and specially adapted shoes with hooks and elastic cords – Coronal plane (A); Sagittal plane (B)

Source: Research data.



**Figure 2** - Ability exercise unit (spider and monkey cage)

Source: Research data.

The versatility of the ability exercise unit is that it combines the fun for the patient and also substitutes the work of two additional people. Parallel bars installed inside the ability exercise unit allow one to combine any of the previously mentioned concepts with gait training, functional skills and transfers. It can be done either with the use of the “spider” tracking rail or independently. Very often the parallel bars are replaced with two suspended ropes, creating a version of a “suspended bridge”. Children sometimes refer to the ability exercise unit as the “monkey and spider cage”.

#### Phase 1 – warm up and stretching (45 min)

The patient is positioned on a table where the skin brushing protocol (upper and lower limb and trunk) is done during approximately 15 minutes. The warm up activities consist in active and passive stretching at main joints (wrist, elbow, shoulder, ankle, knee and hip, joint compression). This procedure takes about 30 minutes.

Krueger et al. (19) claim that physical stimulus can trigger action potentials at the neuronal level, in this sense, Wood et al. (15) studied the effects of the brushing on the excitability of the triceps surae motoneurone pool, using the Hoffmann reflex (H reflex) as a measure of this excitability. The experiment was performed with neurologically normal subjects on a total of twenty-two (five males, seventeen females). The cutaneous stimulation was produced by light brushing of the skin overlying triceps surae muscles, using a standard 1 cm diameter soft paintbrush. The area of skin stimulated was 2 cm x 10 cm, running along the length of the muscle, and brushing was performed in a distal to proximal direction.

#### Pronation/Supination Stretch

While the child is lying on his back, place his arm slightly away from his body. Use one hand to stabilize just above the elbow. Then apply a gentle downward pressure turning the palm of the hand down towards the floor. Hold this for 20 seconds before slowly turning the palm up towards the ceiling. Again apply a gentle over pressure and hold for 20 seconds. This is one stretch; repeat three to five times on each arm. This can be done three to five times a week.

#### Trunk Rotation Stretch (single leg stretch or with both legs together)

Place child laid on his back, bend one leg up with hand on knee, and rotate it towards the opposite side stretching the obliques. Place your other hand on chest or shoulder to stabilize trunk. Do not allow the upper body to come off of the floor. Hold this for a count of 30 seconds, and then repeat three to five times to both sides. This can be done five times a week.

## Phase 2 – Suit

It is donned on the patient a soft dynamic proprioceptive orthosis called *the suit* and attached the elastic cords in the specific suit places in order to correct postural deviations. The suit aligns the body as close to normal as possible. Reestablishing the correct postural alignment plays a crucial role in normalizing muscle tone, sensory and vestibular function. Following donning of the suit, activities as weight bearing, mobility, agility, coordination, weight shifting, balance, transitioning, motor planning and strengthening are done.

The suit is used to train a child to gain the ability to isolate the desired movements and strengthen the muscle groups responsible for that movement. The suit allows one to gain range of motion, muscle and joint flexibility, as well as functional skills.

A patient, while wearing the suit goes through various exercises including “how to walk”. The suit works as an elastic frame surrounding the body and does not limit the amplitude of movement but adds an additional weight load on it within designed limits. The suit serves as an external skeletal support for patients with neuromuscular disorders (including Cerebral Palsy). The suit facilitates independence in the development of new gross and fine motor skills like sitting, standing, and walking. When worn during and in conjunction with physical therapy, the suit can accelerate a child’s progress due to the proprioceptive stimulation increase (1, 20).

## Phase 3 – “Monkey cage”

The ability exercise unit is also extremely helpful while working on specific goals like endurance for a certain skill. With the use of the tracking rail (Figure 3), the patient and the therapist work on the proper coordination of the movement (for example: reciprocation), the quality of the movement and endurance. It is very helpful and often used in the center of the study as a dynamic stander. Patients learn the concept of weight shifting and weight bearing along with the consequences of its lack in a safe way.

## Phase 4 – “Spider cage”

In the spider cage, the children are hooked up a belt around their waist that is attached to the cage

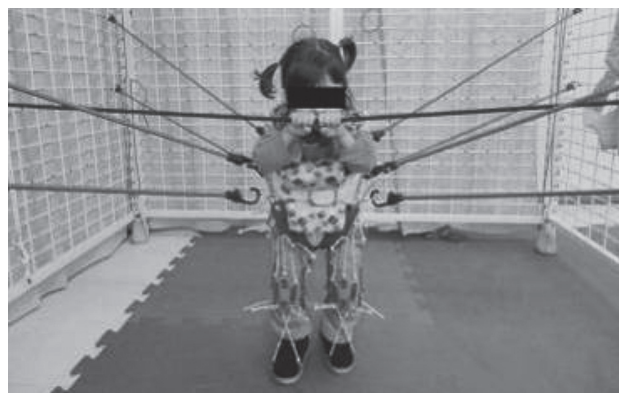
using bungee cords (Figure 4). The bungee cords adjustment is just enough to allow the child the security and balance needed to practice activities on their own. The cage also allows the child and therapist to work on activities that would normally take two or three therapists to work on, by acting as extra hands.

Children are able to accomplish activities in the spider cage that they are not able to do without the assistance of the bungee cords. Depending on the way the bungee cords are placed, one can practice sitting, kneeling, quadruped, standing, strengthening exercises, jumping (Figure 5) and many other activities.

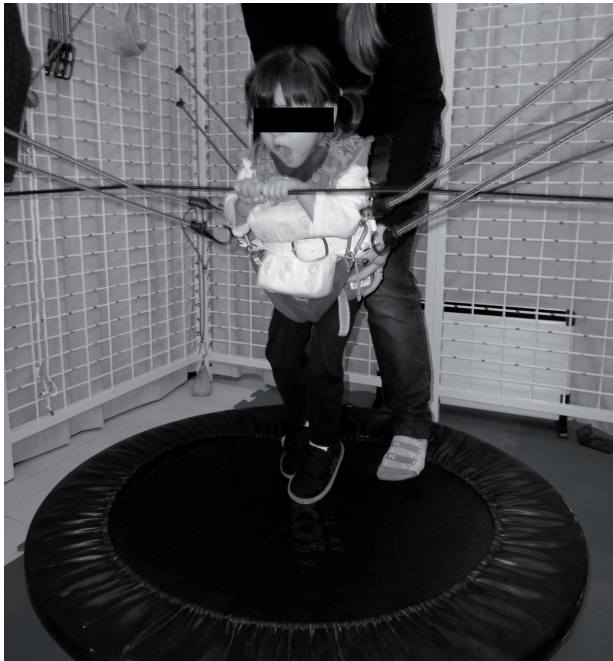
This way, the four phases of the PediaSuit Protocol™ bring a wide incentive promotion which is directly related to each child needs. The advantage of the protocol is that it allows applying holistic and specific stimulus to patients, progressively, and it can be modified each time the therapists realize that such modification provides benefits to the patient.



**Figure 3** - Patient using the tracking rail in the monkey cage  
Source: Research data.



**Figure 4** - Patient alone at spider cage with the bungee cords  
Source: Research data.



**Figure 5** - Spider cage with extra equipments

Source: Research data.

## Other considerations

PediaSuit Protocol™ therapy increases deep proprioceptive awareness and positions the child in a more ideal alignment during various activities. Re-establishing the correct postural alignment plays a crucial role in normalizing muscle tone, sensory and vestibular function (21-23).

The suit aligns the body as close as possible to normal and the idea is to move body parts against resistance, thus improving muscle strength (20). An attached series of elastic cords provides compression to the body's joints (tactile stimulation) and resistance to muscles when movement occurs. Through placement of the elastic cords, selected muscle groups can be exercised as the patient moves limbs, thus, suit therapy is a form of controlled exercise against resistance.

Neves et al. (14) found out in a case study of the PediaSuit™ rehabilitation with a spastic diplegia patient that there was improvement in motor function, body composition and ankle range of motion in response to the protocol applied. These finds corroborate what we have observed in the PediaSuit Protocol™ clinics.

Intensive integrated physical therapy programs are customized to fit the needs of each child, with specific functional goals and usually involve a

rehabilitation program that includes about 200 minutes of exercise per day for 6 days a week, including 90 to 120 minutes of the suit application.

PediaSuit™ therapy is often used as part of a comprehensive program of intensive physiotherapy that consists in five to seven hours a day for four weeks (24). It combines the best elements of various techniques and methods, and has a sound rationale based on exercise physiology. It is important to note that use of the suit is only one component of an overall approach. Parental involvement is highly encouraged and parents are often part of the treatment program. It needs to be mentioned, however, that a true intensive therapy program is not merely doing the same exercise over and over again, but rather is a structured approach to physical activity with consideration to the person's individual cycles of progressive overload (25, 26), fatigue and recovery (27-29).

Intensive pediatric therapy is usually an 80 hours program over four weeks. With traditional therapy, 80 hours would normally be delivered over 30 weeks (avg. two hours per week) or seven and a half months. Children require repetition to learn new tasks and they need, at least, 12 weeks intervention period so that differences in physical activity can be quantified (30). Children with disabilities require many more repetitions to learn the same task, often thousands compared to hundreds of repetitions (31), and the intensive therapy helps to accomplish this goal.

While strengthening muscles and improving function, the system of exercises performed in the ability exercise unit contributes to gains in range of motion, both active and passive, and improved muscle flexibility and tone, promoting good benefits (20, 32) for the cerebral palsy population (33). According to Wu et al. (33), passive stretching combined with engaging in active movement training with CP children demonstrated improvements in joint biomechanical properties, motor control performance, and functional capability in balance and mobility.

Children's physical development and movement is linked closely to other aspects of their daily learning. It is influenced by their growing confidence and enjoyment of physical play, by their increasing ability to control their own bodies through movement and by their physical well-being and strength (34).

As children develop physically, they become faster, stronger, more mobile and more secure by their balance, and they start to use these skills in a wider range of physical activities and also become more aware of

themselves as individuals. This developing sense of identity is linked closely to their own self image, self-esteem and confidence. All the benefits highlighted above come through the thought of Palisano et al. (35), who call the attention to the importance of programs that emphasize lifelong fitness, weight control, and conditioning.

## Conclusion

The PediaSuit Protocol™ is customized to fit the needs of each child, with specific functional goals and usually involves an intensive rehabilitation program. It combines the best elements of various techniques and methods, and has a sound rationale based on exercise physiology. It is important to note that the use of the suit is only one component of an overall approach. This protocol anticipates results obtained only with long periods of conventional physical therapy (i.e. half to one hour per day, one to three days per week).

Parental involvement is highly encouraged and parents are often part of the treatment program. It needs to be mentioned, however, that a true intensive therapy program is not merely doing the same exercise over and over again, but rather is a structured approach to physical activity with consideration to the person's individual cycles of progressive overload, fatigue and recovery.

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