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Case report

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Effects of the practice of the body weight support in children with cerebral paralysis: a series of cases

Efeitos da prática do suporte de peso corporal em crianças com paralisia cerebral: uma série de casos

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RESUMO | INTRODUÇÃO: A paralisia cerebral (PC) é a causa mais comum de incapacidade motora na infância. Essa lesão cerebral pode resultar em comprometimentos neuromotores variados que, geralmente, estão associados à gravidade da sequela e a idade da criança. **OBJETIVO:** Avaliar a influência do Suporte de Peso Corporal (SPC) sobre a função motora e flexibilidade de crianças com paralisia cerebral. **MÉTODO:** Participaram do estudo sete crianças que não apresentavam o padrão de marcha, GMFCS nível IV e V, onde foi realizada a identificação do desempenho da função motora grossa por meio da Gross Motor Function Measure (GMFM), da flexibilidade por meio do teste Flexiteste,e do número de passos e distância percorrida antes e após um ano de tratamento com SPC em esteira ergométrica. Tendo assistência de dois terapeutas que auxiliavam em pontos chaves de joelho e tornozelo simulando o padrão de marcha da criança. As sessões foram realizadas uma vez por semana, durante 30 minutos. **RESULTADO:** O GMFM apresentou aumento das pontuações obtidas antes e após o tratamento, onde os itens deitar e rolar tiveram aumento de 14,09%, sentar teve aumento de 10,43%, engatinhar e ajoelhar teve, aumento de 7,27%, e por fim, o item em pé teve aumento de 8,10%. A variável flexibilidade apresentou diferença antes e após o tratamento, obtendo como flexibilidade inicial pequena e final médio negativa, com aumento de 7,85 pontos. Já o número de passos teve aumento de 175 passos e a distância percorrida de 132 metros. **CONCLUSÃO:** Para estudos futuros, que busquem verificar a eficácia do SPC no tratamento de crianças não ambulantes, sugere-se a utilização de amostras maiores, e comparações com grupos controle ou que realizam outras terapias.

PALAVRAS-CHAVE: Fisioterapia. Criança. Paralisia cerebral. Suporte de peso corporal.

ABSTRACT | INTRODUCTION: Cerebral palsy (CP) is the most common cause of motor disability in childhood. This brain injury can result in varied neuromotor compromises that are usually associated with the severity of the sequela and the child's age. **OBJECTIVE:** To evaluate the influence of the Body Weight Support (SPC) on the motor function and flexibility of children with cerebral palsy. **METHODS:** Seven children who did not present gait pattern, GMFCS level IV and V, participated in the study, where the identification of the gross motor function performance was performed through the Gross Motor Function Measure (GMFM), flexibility using the Flexitest test , and the number of steps and distance traveled before and after one year of SPC treadmill treatment. With assistance from two therapists assisting in key knee and ankle points simulating the child's gait pattern. The sessions were held once a week for 30 minutes. **RESULTS:** The GMFM showed an increase of the scores obtained before and after the treatment, where the items of throwing and rolling had an increase of 14.09%, sitting had an increase of 10.43%, crawling and kneeling had an increase of 7.27% and finally, the standing item increased by 8.10%. The flexibility variable showed difference before and after treatment, obtaining as initial small flexibility and medium negative end, with increase of 7.85 points. However, the number of steps increased by 175 steps and the distance covered by 132 meters. **CONCLUSION:** The proposed physiotherapeutic treatment (SPC) presented to these patients with cerebral palsy was efficient and could increase motor performance, flexibility, number of steps and distance traveled.

KEYWORDS: Physiotherapy. Child. Cerebral palsy. Body weight support.

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Introduction

Cerebral palsy (CP) is the most common cause of motor disability in childhood, affecting about two in every 1,000 children born in the world1. It is a disorder of posture and movement, resulting from non-progressive encephalopathy in the pre, peri or postnatal periods, with a single or multiple localization in the immature brain[2]. This brain injury may result in varied neuromotor compromises that are usually associated with the severity of the sequela and the child's age[3].

In Brazil, it is estimated that every 1,000 children who are born, 7 are carriers of PC4, this condition may be related to gestational problems, poor maternal and infant nutrition, and often inadequate medical and hospital care, given the demand of the conditions clinics presented mainly by children born before the correct neurological maturation[1], being preterm birth one of the causes of CP, and is present in about 30% of live births[2].

CP affects the individual in different ways, depending on the area of the affected nervous system5. The individual presenting with CP has neuromuscular changes, such as variations in muscle tone, persistence of primitive reflexes, stiffness, spasticity, among others[2,3]. Such changes usually manifest with specific patterns of posture and movements that may compromise the functional performance of these children[3] . Consequently, CP can significantly interfere in the child's interaction in relevant contexts, thus influencing the acquisition and performance of not only basic motor frames (rolling, sitting, crawling, walking), but also activities of the daily routine, such as bathing, feeding, dressing, moving around in varied environments, among others[6]. Although the CP condition may result in somewhat predictable changes in the musculoskeletal system, the functional manifestations of this condition should be assessed individually, since functional performance is influenced not only by the intrinsic properties of the child but also by the specific demands of the task and by the characteristics of the environment in which the child interacts[7].

Some treatment protocols demonstrate an increase in the motor rehabilitation of these children, thus physiotherapy is capable of proposing and restoring the functions of the body8. Since the physiotherapeutic approach is intended to prepare the child for a function, to maintain or improve the existing one[7].

This research is justified from the physiotherapeutic treatment that in this case aims to minimize the consequences and promote the maximum possible function using techniques to decrease muscle hypertonia, minimize secondary problems such as shortening and contractures, increase range of motion, maximize the selective motor control, muscle strength and the patient's motor coordination.

Thus, the purpose of this study was to evaluate the influence of the Body Weight Support (SPC) on the motor function and flexibility of children with cerebral palsy.

Methods

Type of research

This research is an exploratory study, series of cases. Being possible to be measured in numbers, classified and analyzed, using statistical techniques, and its classification is given in exploratory because it has little information regarding the object of study.

Sample

Seven non-wandering children with a diagnosis of cerebral palsy, aged between 4 and 7 years (table 1), were selected to be probabilistic. Participants who met the following criteria were included in the study: GMFCS level IV or V; and no cardiopulmonary dysfunction will complete the proposed training and could not withdraw from the survey at any time. The following were excluded from the study: excessive ligament lassitude of the first cervical vertebrae (atlas-axis); decubitus ulcers in the pelvic or lower limb region; any other medical contraindication to the performance of the gait.

Table 1. Classification of the sample according to gender, age and type of cerebral

Subject	Sex	Age	Type of Cerebral Palsy
1	M	4,1	Diplegia / spastic
2	M	4,5	Diplegia / spastic
3	M	4,9	Tetraplegia / spastic
4	M	6,7	Tetraplegia / spastic
5	M	6,7	Tetraplegia / spastic
6	F	4,4	Tetraplegia / spastic
7	F	6,2	Tetraplegia / spastic

The evaluation and intervention methods used in this study were approved by the Ethics and Research Committee of the State University of Santa Catarina, through ruling number 1,218,446 (CAAE 46857215.7.0000.0118).

After the participants' choice, they were asked to sign a Free and Informed Consent Form, the authorization of the parents or guardians of the children selected for their participation in the study.

Procedure

The initial stage of the study comprised an anamnesis, such as the application of an evaluation form containing identification data and anthropometric measurements.

The following tests were then applied: assessment of flexibility through the application of Flexitest and evaluation of gross motor function through Gross Motor Function Classification Measurement (GMFM). The tests were applied on the first day of treatment and reapplied at the end of the last day after a period of one year of treatment.

The FlexiTest is an evaluation method based on a comparative analysis between the mobility actually obtained and that registered in standardized evaluation maps for twenty joint movements9. According to Araújo, 10 this methodology encompasses joints of the ankle, knee, hip, trunk, wrist, elbow and shoulder, totaling 20 joint movements (36 if considered bilaterally). Eight movements are made on the lower limbs, three on the trunk and the remaining nine on the upper limbs. The numbering of the movements is done from proximal to distal. Each of the movements is measured on a scale by increasing the number of integers from 0 to 4, resulting in a total of five possible values.

Considering that the Flexitest consists of the measurement and evaluation of the maximum passive mobility, the slow execution of the movement is performed with each participant, comparing the values of maximum amplitude reached with the standardized evaluation maps. The analysis of this method is done for each movement individually. However, at the end of the evaluation, the results are summed in order to obtain a generative index of flexibility ranging from 0 to 80 points. This index is called Flexindex and its description is made as follows: A) very small flexibility, less than 20 points; B) small 21 to 30 points; C) negative means 31 to 40 points; D) positive mean of 41 to 50 points; E) large 51 to 60 points; F) very large,> 60 points.

The GMFM is an instrument that evaluates the wide motricity, quantitatively, initially intended for children with PC[11] describes their level of function without considering the quality of the performance, however it represents the improvement in the protocol of treatment, as in the quality of life of the patients evaluated12. The GMFM quantitatively evaluates functional tasks. It is a scale of confidence and sensitivity to discover important clinical changes in the gross motor function of children with the most diverse neurological and motor pathologies. This test consists of 88 items, divided into five dimensions: A) Lying and Rolling - formed by 17 items; B) Sitting-20 items; C) Crawling and Kneeling - 14 items; D) Standing- 13 items; E) Walking, Running and Skipping- 24 items. Each item evaluated receives a score of 0 to 3, being: 0 - Inactivity of the child against the requested activity; 1 - Initiates the proposed movement independently, executing less than 10% of the movement; 2 - Perform movement partially 90% of movement and 3 - Completes movement or suggested posture completely. At the end of the evaluation, the points obtained by the child in each dimension are added, converting in percentage in relation to the maximum score in the dimension.

During the evaluation the children wore comfortable clothes that allowed total freedom of movement. Each child was placed on a mat for the physiotherapeutic evaluation and toys were used to stimulate the decubitus changes and acquisition of specific postures. The child was allowed a maximum of three attempts, and the spontaneous performance of any item considered valid. Verbal encouragement or demonstration of any item was allowed.

The number of steps and distance traveled was analyzed from the initial / final filming of the gait pattern performed, thus, comparing the variables. All analyzes of the data were performed from a pre and post test evaluation to measure the weight support effect in children with cerebral palsy.

Protocol

The SPC treadmill treatment was performed at the Clinical School of Physiotherapy of the Health and Sports Sciences Center of the State University of Santa Catarina - CEFID / UDESC - Florianópolis / SC. The sessions were performed for 30 minutes once a week, during a year of treatment, totaling 48 visits (2 evaluations and 46 sessions in SPC with treadmill).

The gait training was performed with a partial weight suspension (patient) to facilitate gait. The suspension was set at approximately 60 to 90% of body weight. The treadmill care was applied with speed from 1 km / h to 3 km / h, according to patient comfort. To facilitate gait movement, two therapists assisted on key knee and ankle sites, simulating the movements of the lower limbs to promote walking in children. For the measurement of the percentage of weight support an extensometric load cell was used, ring-shaped, maximal load / sensitivity of 3000/2 N and error less than 1%, which was fixed above the child by checking the weight of body suspension.

The distance traveled was counted through the number of turns of the sliding floor of the mat (canvas) where an established marker was located, thus finding, the number of turns multiplied to the mat size of the mat, already the number of steps was taken from the filming of treatment sessions, where the researcher later visualized and recorded.

Results

Initially a protocol of measurement of the gross motor function of the patients (GMFM) was carried out, being these scored in the 1- Deitar e Rolar scale; 2-Seat; 3- Crawling and Kneeling; and 4- Standing.

The dimensions of the results of the GMFM are shown in the table of number 2, where the children had increase in the dimensions, Lying and rolling of 14.09%, the item Sentar had an increase of 10.43%, already the item Crawl and kneeling had an increase of 7.27%, and finally, the standing item had an increase of 8.10%.

Table 2. GMFM results before and after treatment. N = 7

Evaluation	1	2	3	4	5	6	7	Average
Lying and rolling start	62,74%	52,94%	94,11%	64,70%	72,54%	45,09%	60,78%	64,70%
Lying and rolling end	**86,27%**	**63,33%**	**98,03%**	**82,35%**	**80,39%**	**64,70%**	**76,47%**	**78,79%**
Sit start	60,33%	48,33%	91,66%	60%	70%	43,33%	65%	62,66%
Sit end	**75%**	**60%**	**93,33%**	**78,33%**	**81,66%**	**51,66%**	**71,66%**	**73,09%**
Crawl and kneel start	47,62%	44,38%	80,95%	59,52%	69,05%	28,57%	35,71%	52,25%
Crawl and Kneel End	**54,76%**	**50%**	**83,33%**	**69,04%**	**71,42%**	**40,47%**	**47,61%**	**59,52%**
Stand Start	11,28%		33,33%	23,07%	25,64%			23,33%
Stand End	**25,64%**		**41,02%**	**30,76%**	**28,20%**			**31,43%**

From the results presented in the gross motor function scale it can be inferred that after the intervention with SPC on treadmill there were motor improvements, especially in the roll / roll functions; to sit; crawling / kneeling and standing where all patients achieved an increase in their percentage before and after treatment.

In the evaluation of flexibility according to table 3, the result of the flexindex had an initial score of 28 points (small flexibility). At the end of the treatment, the flexion index obtained a score of 35.85 points (mean negative flexibility), with an increase of 7.85 points.

The number of steps increased by approximately 175 steps, and the distance covered increased by approximately 132 meters according to table 3.

Table 3. Flexitest result, number of steps and distance traveled before and after treatment. N = 7

Evaluation	1	2	3	4	5	6	7	Average
Flexitest home	25	28	33	27	29	26	28	28
Flexitest end	**31**	**35**	**40**	**36**	**37**	**35**	**37**	**35,85**
Number of steps home	378	293	535	327	609	591	458	455,85
Number of steps end	**492**	**394**	**697**	**521**	**834**	**805**	**676**	**631,28**
Distance traveled home	285	203	347	296	381	375	303	312,85
Distance traveled end	**349**	**315**	**489**	**407**	**563**	**543**	**450**	**445,14**

Discussion

From the results of this study, it was verified that the patients who received treatment by means of walking training with SPC on treadmill had an increase in the parameters of gross motor function (GMFM), flexibility (Flexitest), number of steps and distance traveled.

It is believed that rehabilitation using treadmill walking training is considered an adequate treatment to facilitate or improve gait pattern. Recovering or developing walking ability is of great importance to neurological patients and is one of the main objectives of their rehabilitation programs[13]. Also, this treatment has been shown to be an effective alternative in improving gross motor function and flexibility of patients[14] facilitating movements by acquiring adequate motor patterns, which results in improved strength, range of motion and basic motor skills for mobility according to distance traveled and number of steps.

The goals of this rehabilitation program were to reduce disability and improve function, as well as flexibility. For that, a scale of measurement of the gross motor control was applied where a directional resource was obtained to idealize the pre-programmed activities. By realizing their capacities and limitations, it was possible to make possible the best execution of movements and flexibility already present, as well as to stimulate new postures following an evolutionary scale[15].

The results showed that an increase in the percentage of all GMFM items was obtained, with the item Lying and Rolling showing the greatest change, with a percentage of 14.09%, the item Sentar had an increase of 10.43% ; the item Crawling and kneeling increased by 7.27%, and finally, the standing item increased by 8.10%. This gives us an indication that treadmill and SPC treatment may potentiate motor performance and motor skills, according to the Visser study[6], in which participants, children with CP aged 6 to 16, demonstrated significant improvements in locomotion and functional mobility at the conclusion of an intervention program carried out at home for 12 weeks.

Also, in the Kenyon study 16, which presented a series of cases to explore the results obtained with SPC treatment in children with CP, two of the three participants demonstrated improvements in post-intervention functional mobility. In addition, it should be noted that the families of the three participants showed good acceptance and reported having enjoyed the SPC program. This is corroborated by the study by Reiffer[17], who reports that children

with CP and their parents have the ability to travel, revealing the importance of SPC treatment in relation to other treatment interventions.

In the evaluation of flexibility from the Flexitest, the children obtained an increase of 7.85 points, demonstrating that the treatment is favorable to increase motor performance, from a small flexibility to a negative mean, which demonstrates that the therapeutic intervention with SPC favors the increase in joint range of motion.

No studies were found that correlated SPC and flexibility with the purpose of comparing treadmill training with partial weight suspension[18], however, it is known that the greater the flexibility of the child, the better the gait training[19].

These results may reveal that, although it is not possible to promote a gait prognosis for non-ambulatory children, there are palpable perspectives on the ability of the SPC treatment to generate an improvement in the walking pattern of such patients, promoting, facilitating or improving the walking pattern.

In general, patients had the experience of acquiring more agility and gradually more body awareness and movement control. An early treatment with the purpose of counting on the advantages of plasticity and neural adaptations allows the patient to experiment with movements and postures that he would not have access due to his neurological condition and among these therapeutic modalities is the rehabilitation of gait with SPC[14, 20].

Thus, we evaluated that SPC on a treadmill is a rehabilitation tool that can aid in the development of the neuromotor framework of pediatric patients. Having as difficulties encountered the position of the therapist to perform the therapy in the patient and the number of therapists to assist in the gait pattern of the patient. However, the advantages of this treatment are that it is easier for treadmill training, since the weight of the patient is partially supported, greater safety, with less risk or fear of fall by the patient, since the torso is supported by the body. SPC and greater possibility of anticipation of gait training in relation to conventional training in soil. Evolving with favorable prognoses for gross motor function, flexibility, number of steps and distance traveled.

For future studies that seek to verify the efficacy of SPC in the treatment of non-ambulatory children, it is suggested to use larger samples, and comparisons with control groups or other therapies.

Conclusion

The child with PC exhibits complex results from a brain injury or an error in brain development. As the child grows, other factors combine with the effects of the injury to aggravate functional deficiencies. These factors are part of the effects of lack of motor activity and decreased flexibility of the musculoskeletal system. The acquisition of motor control and motor skills is acquired through the progressive modification of the nervous system, which is characterized by the changes occurring in the synaptic connections, and these connections are dependent on the use and physical therapy manipulation.

SPC treadmill treatment may potentiate the functional performance of non-ambulatory children, allowing for the development of gross motor function and flexibility. Thus, it is expected a greater functional independence of these children in activities of daily living and a better quality of life.

Therapy assists individuals' autonomy, benefits from early, intensive practice and in the context of the task, provides immediate feedback on the child's performance and can lead to a secondary context, that is, to provide greater motor autonomy through training.

Author contributions

Reitz GS, Chirolli MJ, Gantzel LC and Lunardelli BS participated in the study design, search and analysis of research data, results interpretation, and writing of the scientific article. Pereira SM participated in the research data interpretation, and writing of the paper. Roesler H participated in the study design, statistical analysis of the research data and interpretation of the results.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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