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Original Article

Intensive care protocol for infants with asymmetry

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Abstract: Introduction: Injuries to the developing central nervous system can cause changes in muscle tone, coordination, and balance, as well as asymmetry of the upper limbs resulting in more obvious functional limitations in a body hemisphere and restriction in the social participation of children. Objective: Based on the principle that therapy is more effective when started at an early age, the objective of this study was to develop a modified CIMT protocol (*Constraint-Induced Movement Therapy*) in association with HABIT (*Hand-Arm Bimanual Intensive Therapy*) and investigate the effects in infants with hemiparesis or asymmetry of upper limbs. Method: Five infants aged 6 to 24 months who presented asymmetry of the upper limbs participated in the study. The General and Objective Manual Evaluation of Infants (AMIGO) was used to evaluate the motor function of the upper limbs. The Pediatric Evaluation of Disability Inventory (PEDI) was carried out with the caregivers in order to evaluate their perception of the functional participation of the infant in daily tasks. All evaluations were performed before and immediately after the intervention, and 4 months after protocol development for follow-up recording. The data were analyzed descriptively and by means of analysis using the Jacobson-Truax method. Results: A significant increase in the spontaneous use of the more compromised upper limb was observed in infants with fine and gross motor tasks. Conclusion: The adapted protocol used toys and tasks appropriate to the age and was effective in producing a quantitative and qualitative increase in the use of the most compromised upper limb as well as in the unimanual and bimanual function.

Keywords: *Early Intervention, Infant, Rehabilitation, Upper Extremity, Intensive Therapy.*

Protocolo de intervenção de terapia intensiva para lactentes com assimetria

Resumo: Introdução: Lesões no sistema nervoso central em desenvolvimento podem causar alterações de tônus, de coordenação e de equilíbrio, assim como assimetria de membros superiores, resultando em limitações funcionais mais evidentes em um hemisfério corporal e restrição na participação social de crianças. Objetivo: Partindo do princípio de que a terapia é mais eficiente quando iniciada em idade precoce, o objetivo deste estudo foi elaborar um protocolo modificado da CIMT (*Constraint-Induced Movement Therapy*) em associação com o HABIT (*Hand-Arm Bimanual Intensive Therapy*) e investigar seus efeitos em lactentes com hemiparesia ou assimetria de membros superiores. Método: Participaram do estudo 5 lactentes com idade entre 6 e 24 meses que apresentaram assimetria dos membros superiores. A Avaliação Manual Infantil Geral e Objetiva (AMIGO) foi utilizada para avaliar a função motora dos membros superiores. O Inventário de Avaliação Pediátrica de Incapacidade (PEDI) foi realizado com os cuidadores, a fim de avaliar a percepção dos mesmos sobre a participação funcional do lactente em tarefas de vida diária. Todas as avaliações foram realizadas antes, imediatamente após a intervenção, e 4 meses após o desenvolvimento do protocolo para registro de *follow-up*. Os dados foram analisados descritivamente e por meio de análise utilizando o método Jacobson-Truax. Resultados: Foi observado nos lactentes, aumento expressivo na utilização espontânea do membro superior mais comprometido em tarefas de motricidade fina e grossa. Conclusão: O protocolo adaptado utilizou brinquedos e tarefas apropriadas à idade e foi eficaz para produzir aumento quantitativo e qualitativo na utilização do membro superior mais comprometido, bem como na função unimanual e bimanual.

Palavras-chave: *Intervenção Precoce, Lactentes, Reabilitação, Membro Superior, Terapia Intensiva.*

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1 Introduction

The upper limbs (UL) are extremely important for the life of human beings because they are closely involved in functional and occupational activities (SILVA; BRACCIALLI; MANZINI, 2009). The necessary movements are performed with the hands for the different essential functions of human beings, such as feeding, writing, reaching, grasping, manipulating, moving objects in space, releasing and throwing them, and routine tasks of self-care (CARVALHO, 2004; CORBETTA, 1998; FERRIGNO, 2007).

From an early age, the human being interacts and recognizes the environment, the other and himself through the upper extremities. Manual skills influence the global, cognitive, emotional, and social motor development, facilitating exploration, interaction, and learning (CHIEN; BROWN; MCDONALD, 2009; FERRIGNO, 2007). Two-fourths of the surface area of the hand in the Central Nervous System (CNS) is related to the motor function of the hand, especially the finger and thumb (FERRIGNO, 2007).

In children with asymmetry of upper limbs by the involvement of a body hemisphere or two body hemispheres (being a member more subtly affected), the less compromised side is predominantly their first choice in performing tasks and handling of objects (HOARE et al., 2007; SKÖLD; JOSEPHSSON; ELIASSON, 2004).

When there is a CNS or peripheral affection, such as cerebral palsy or obstetric injury of the brachial plexus, there is a possibility that the infant may present impairment in the development of manual motor, as well as sensory alteration of the affected upper limb, presenting variability in the age of acquisition of reaching, which may present unimanual dysfunctions, with less success of holding, and bimanual coordination tasks (EVANS et al., 2003; FERRIGNO, 2007). It may cause impairment in the performance of basic activities, such as self-care, to more complex activities such as work and leisure, and consequently interfering with their quality of life (CORBETTA et al., 2005; HADDERS-ALGRA et al., 1999; PEREIRA et al., 2004).

Few intervention techniques or protocols have been performed aiming to improve the manual or bimanual function of children with asymmetry of upper limbs. The Constraint-Induced Movement Therapy (CIMT) (ELIASSON et al., 2005), and Hand-Arm Bimanual Intensive Therapy (HABIT) (GORDON et al., 2007) are highlighted among the existing techniques for the improvement of upper limb function.

The CIMT has a protocol for rehabilitation of motor function and overcoming disuse learned, positively influencing daily tasks and functional independence (ELIASSON et al., 2005; SMANIA, 2006). It is a combination of structured and systematized elements that restrict the non-affected side to encourage the use of the affected limb (CHARLES; GORDON, 2005; TAUB; USWATTE; PIDIKITI, 1999). It is based on three fundamental pillars: (1) the intensive task-oriented therapy training; (2) the set of behavioral methods; and (3) the use of a constraint on the unaffected or less affected upper limb (MORRIS; TAUB; MARK, 2006).

HABIT is also based on the intensive therapy practice, but it has a less stressful proposal since it does not restrict the more functional upper limb. The aim of HABIT is to improve bimanual coordination in the structured activities of daily life and in the ludic activities, aiming at the recovery or functional learning through the motor principles of learning and neuroplasticity. The rehabilitation protocol through HABIT offers games and functional activities that provide structured bimanual practices in a period of 6 hours daily (GORDON et al., 2007). Like the CIMT, the HABIT has been showing positive and satisfactory results in the motor actions of children with asymmetry (NOVAK et al., 2013).

Many studies have been conducted with the child population using the protocols of the CIMT or HABIT, both in their original and modified versions. However, as it is known, none have focused on the practice of the two associated techniques in the treatment of infants. Knowing the importance of stimulation performed as early as possible, this study elaborated, applied and evaluated an intensive therapy intervention protocol based on current techniques (CIMT and HABIT) along with infants with asymmetry of upper limbs.

In this sense, the following research questions are raised: Do infants with asymmetry of upper limbs benefited from a high-intensity intervention? Would an intervention protocol based on current techniques (CIMT and HABIT) be effective for infants?

2 Method

This is a multiple case study of an applied nature, with a quantitative approach and exploratory-descriptive content focused on the rehabilitation of infants with asymmetry. This study covered all ethical aspects of research with human beings according to National Health Council resolution 466/2012, and IT was approved by the Research Ethics Committee of the HCRP, FMRP-USP under opinion number 1,011,008.

2.1 Participants

Infants aged 6 to 24 months old and with asymmetry of the upper limb due to non-evolutionary or degenerative central or peripheral neurological alteration were considered eligible for the study. In this way, infants with unilateral or bilateral type CP evidenced by body asymmetry or with obstetric brachial palsy (OBP) were recruited. This was a convenience sample, and the infants were recruited through open invitation in private clinics and public services of pediatrics and neonatology in 3 medium-sized municipalities in the interior of the state of São Paulo (Brazil). Infants who had received botulinum toxin application within 6 months before the study; who participated in some contention therapy protocol; who did not understand simple verbal commands; who presented hearing or visual impairment (being diagnosed by a qualified professional or observed by the caregivers); or who had no degree of spontaneous active range of motion (assessed observationally by the therapist) were excluded.

2.2 Evaluations

After signing the Informed Consent Form (ICF), the caregivers answered questions from a form prepared by the authors of the study to characterize the sample.

Thus, information on age, gender, and diagnosis of the participant their primary caregiver and their school level, age, and socioeconomic classification were collected through ABEP (ASSOCIAÇÃO..., 2015).

Subsequently, participants with CP were classified according to their functional limitation, using GMFCS E & R (Gross Motor Function Classification System for Cerebral Palsy Expanded and Revised) and Mini-MACS (Mini-Manual Ability Classification System) (ELIASSON et al., 2017; SILVA; PFEIFER; FUNAYAMA, 2013). The functional performance capacity in the home and therapeutic environment was evaluated through PEDI (MANCINI, 2005) and AMIGO (SABINO, 2016).

GMFCS E & R is used to classify the gross motor function of children with CP. It has five levels of classification according to the assistance that the child needs, in which level I represents greater independence and the level V represents total dependency. This classification is divided by age, and this study used the classification for children younger than 2 years (PALISANO et al., 2008). The translation of this classification into Brazilian Portuguese was performed in 2010 and its psychometric properties are already well established. In 2013, a study was carried out in Brazil of within-rater and between-rater reliability, obtaining almost perfect agreement (SILVA; PFEIFER; FUNAYAMA, 2013).

The Mini-MACS is a manual skill classification system for children with CPs and ages between 1 and 4 years old, following the same 5-level classification criteria used in GMFCS E & R (ELIASSON et al., 2017). This version of the classification has not yet been translated into Brazilian Portuguese, but its validity of content and reliability among the evaluators have already been established (SILVA; PFEIFER; FUNAYAMA, 2013). The first version of this classification was translated into the native language of this study. However, it was decided to use the most updated and appropriate version for the age investigated.

The PEDI is a standardized questionnaire, sensitive to small longitudinal changes, with three parts: Part I - assessing the child's role in his/her home environment regarding to tasks and daily activities in the areas of self-care (73 items), mobility (59 items) and social function (65 items); Part II – assessing the child's independence through the help provided by the caregiver, in the context of self-care (8 items), mobility (7 items) and social function (5 items); and finally, Part III - using some modification in the environment to facilitate its execution/performance in functional tasks. In this research, only Part I of the PEDI was applied since the objective focuses on the individual's functional performance of the infant (MANCINI, 2005).

In Part I of the instrument, each task can receive a score of 0 if the child is not able to perform it, or a score of 1 if the child is able to perform it. The scores are given in a quantitative rather than qualitative way, that is, it does not matter if the child makes some adjustment or compensation in the execution of the functional activity. The total gross score of each area is obtained by summing them. From this score, the normative score and the continuous score are obtained. The normative score compares children of the same age group without dysfunctions, while the continuous score represents the child's level of capacity along the items of the scale (MANCINI, 2005).

The questionnaire includes the observation of the parents once it is applied through an interview with the caregiver. It can also be answered by some therapists through their clinical judgment regarding the patient or applied to educators who are familiar with the child or through direct observation during the execution of the tasks. It is appropriate for children aged 6 months to 7 years old. The translation and cross-cultural adaptation of the instrument into Brazilian Portuguese was done by Mancini (2005).

In this research, the interview format was carried out with the caregivers to verify their perceptions for the functional capacity of the child to perform a certain task, regardless of the upper limb of choice and chosen to use the continuous score.

AMIGO is an evaluation instrument of the manual function for children from 0 to 7 years old, which presents a schedule of structured sequential activities for each age group and the criteria for each item evaluated. In general, it considers 2 points to execute the action; 1 point for partial execution of the action, and 0 for non-execution of the action (SABINO, 2016). This instrument is still in the process of psychometric evaluation, but it has already undergone the preliminary validation process and it has been used in the rehabilitation center of the Hospital das Clínicas of Ribeirão Preto as a measure of outcome (SABINO, 2016; HOSPITAL..., 2018). In the present study, AMIGO categories from 6 to 11 months and from 1 to 1 year and 11 months were used, allowing the manual function of the infant to be verified from a professional point of view since it was applied in person by the evaluator.

The evaluations were before, immediately after the intervention, and with 4 months of follow-up; thus, each child was studied in a total of 5 months.

2.3 Protocol

The intervention protocol developed in this study was based on the intensive training of task-oriented therapy, the restriction of the use of the less affected upper limb and on the offer of specific bimanual activities, based on the theoretical foundations of the CIMT and HABIT and adapted to the infant population.

In this way, the present study elaborated an intervention with a restriction of 1 hour daily performed in 5 weekly sessions, for 4 weeks. The protocol was applied by a professional with experience in early intervention, aiming to develop gross and fine motor skills through specific activities and evolutionary complexities that aim at bimanual functionality and a quantitative and qualitative increase in the use of the affected upper limb.

The main adaptations performed in this protocol were for the time of application of the intervention, the type of restriction of the upper limb that are less affected and the structured activities, to facilitate the participation of infants aged between 6 months and 2 years old, since, as quoted in the introduction, until now, there are no specific studies of the CIMT and HABIT next to this population.

Protocol Application: Intervention sessions of 1 hour daily were defined, considering that this time of rehabilitation is intensive for infants. According to the Educational Guidelines for Early Stimulation, early stimulation for children up to 2 years old, in individual care, should be performed in two weekly sessions with a maximum duration of 40 minutes (BRASIL, 1995).

Restriction type: It was decided to use the removable glove since it allows and facilitates bimanual development in tasks. This option does not exclude the containment character of the CIMT and considers the proposals of HABIT, once the hand not affected is recruited mainly as support in the structured tasks, being able to participate actively in the proposed activities. This restriction was not maintained in the home environment but remained throughout the session. The glove was made of neoprene material and velcro to adjust the size. The chosen model followed a ludic pattern in fish format.

Structured activities: A database of sensorial and motor activities was elaborated (Tables 1 and 2) in which according to the literature, they are activities whose typical abilities comprise the age range of the participants of this study (BURNS; MACDONALD, 1999; FRANKENBURG et al., 1992; MANCINI, 2005; TECKLIN, 2002). The proposed activities favor the involvement of both hands, so the actions necessary for the execution enable the repetition of movements, leading to the improvement of performance from motor learning. With improved performance in the execution of an activity, the level of difficulty was elevated to a more challenging level among the infant's abilities.

The service room had the following materials: 5 wooden benches with the following measures 38×65 cm, 33×60 cm, 26×55 cm, 20×50 cm, 14×45 cm, 1 Folding Screen to define the service area, 2 EVA mats (1×1×20 cm with teeth), mattress (95×55×3.5 cm), 2 positioning rollers (15×50 cm and 20×50 cm) and lumbar wedge (50×50×20 cm), EVA sensory mat and toys of varied sizes and textures.

Caregivers were present at all meetings, able to participate actively in the therapy and received

Table 1. Activities by domain of grasp and grasp.

Task	Material	Description	Adaptation	Progression
Reaching an object	Colored objects of different sizes and textures (rattles, balls, felt-tip toy)	Reaching objects with the affected hands offered in different spatial positions (right, left, midline, the height of the shoulder, the head or above the head). Hand not affected → postural support.	Offering an object closer to the baby's trunk; and the projection side.	Increasing the distance of the object; contrary to the functional projection of the baby; performing postural transitions to achieve.
Holding a utensil	Colorful objects of different sizes and textures	Using the affected hand to hold and keep the object in the hand, while a song was sung or some game was offered.	Light and small objects (slightly smaller than the palm of the hand) and keep it for a short time	Larger and heavier objects and holding them longer
Taking a small object	Colored gel jelly and container	Dipping the hand into the container full of colored balls and grabbing them	Medium line container available	Placing the container in different spatial positions.
Touching body parts	-----	Using the affected hand to touch parts of the body	-----	-----
Sticking and unsticking	Objects with Velcro (small animals and felt balls of different sizes) and Velcro panel	Sticking the object on the panel with the affected hand. The other hand supports the panel or performs postural support depending on the position of the panel. Unsticking the object.	Placing the panel on the table and at the height of the baby's hand. Only asking the child to stick the object.	Placing the panel vertically and on the side of the child. Asking the child to stick and scrape the object (to unstick it, the baby needs to get strength and muscle control)
Taking an object on 4 supports	Colorful objects of different sizes and textures	In the posture of 4 supports, taking with the affected hand a toy of greater interest.	Not reaching (remain in posture while watching a video or while singing a song)	Reaching the object in the posture of 4 supports, leaving the unaffected hand on the ground and progressing to the affected hand as support.
Position rings	Colored rings and a wooden bar	Putting the rings on the wooden bar.	Placing the rings on the unaffected arm.	Positioning the wooden bar in more distant places, lower or higher than the height of the hand.
Storing small objects in a container	Marbles or "ping pong" balls, plastic box, and mug.	Removing the marbles from within a wide-mouthed box and placing them inside a plastic mug. The unaffected hand supports the mug.	The box in the affected side and the mug on the Midline; pick up the ball with palmar grip and/or use a "ping pong" ball.	The box on the middle line and mug from the affected side. Containers at different heights; picking up the ball with 2-finger tweezers (thumb/index finger)
Pressing/ triggering	Toys with buttons that when triggered, they emit sounds or lights up.	Pressing the button with the affected hand. The affected hand was used to support the toy.	Button closer to the child, offering it on the affected side	Button farthest away (on the midline and then on the side opposite the affected limb, so the child should cross the midline to reach)
Cubes in the box	Icebreaker game	Moving the small cubes from the table to a box	Leaving the cubes and the box in front of the affected side	Placing the cubes on the unaffected side and the box on the affected side. Reverse the situation

Table 2. Activities by object manipulation.

Task	Material	Description	Adaptation	Progression
Handling toys	Objects of different sizes and textures	In the sitting position, playing freely with objects of different sizes and textures	Support of the unaffected or external hand, if necessary	Playing in the midline without the support and inserting situations of postural imbalance
Playing soccer	Ball of different sizes	Throwing the ball into the basket or goal using the affected hand and then both hands simultaneously	Small, light and soft balls. Delimiting a large space for the goal.	Larger balls; decreasing the target; placing the target in a more distant, higher and further away from the affected hemisphere.
Modeling	Play Dough	Squeezing the dough making rolls, balls, and spread the dough making “pizza”. The unaffected hand was used as support	Deliver a greater amount of play dough	The lower amount of dough, decreasing the diameter of the rolls, the balls and the thickness of the “pizza”.
Coloring	Paper and gouache	Putting the hand in the container with paint and bring the hand to the paper sheet painting freely. The unaffected hand supports the paper sheet.	The ink container is placed next to the affected hand	Placing the container next to the affected hand, but further away; evolving by placing the pot on the unaffected side
Drawing	Wax chalk, pen, and paper	Drawing with the wax chalk on the paper, using the affected hand. The unaffected hand is on the table and supports the paper	Large wax crayon, wax chalk	Small diameter wax chalk; paper farthest from the trunk.
Assembling parts	Game of grimaces	Picking up the pieces and making the faces. The pieces of this game are large and the non-stressed hand supports the board	Board close to the body and parts available next to the affected limb	Board away from the body of pieces on the unaffected side
Stacking blocks	Set of baby lego and/or colored cubes	Assembling a tower on the table using the largest number of pieces. The unaffected hand supports the tower	Cubes arranged in front of the patient’s midline or the affected side	Placing the blocks on the floor or on the unaffected side.
Hammering	Icebreaker game	Cubes positioned by the infant and the therapist on the play table and the baby should hit the cubes to knock down the pieces	Hitting with the hands	Hitting with the hammer.
Opening a pot	Plastic Box	Removing the lid from the box. The unaffected hand holds the trunk-supported box and the baby removes the lid with the affected hand.	Removing the cover unscrewed.	Unscrewing the lid and remove it

*Grapes without seed.

Table 2. Contined...

Task	Material	Description	Adaptation	Progression
Transferring the container food	Plastic set with cooking utensils,* grape, and raw beans	Transferring the food from the shallow dish and passing to the bottom plate, using the affected hand	Transferring the grapes* with the hand	Transferring the beans by making 2-finger forceps (to develop greater accuracy of the fine forceps), as progression, passing the beans from the bottom plate to the shallow dish; performing the task using a spoon.
Feeding the doll	Raw beans and grapes*	The infant had to pick up the beans or the grape* with the unaffected hand and "feed the doll".	Dolls and container with food near the infant	As a progression, do the same with the use of a spoon.
Self-feeding	Food and container brought by caregivers	Feeding by the hand, taking food out of a container	Big foods like cookies, strawberries, for example	The food should be smaller requiring finer tweezers and then the infant should be fed using a spoon
Fitting pin and/or threads	Board with pins and threads	Taking the pieces on the side and fitting them in the indicated places	Using threads and board near the infant's torso	Using more pins and boards
Pushing a doll cart	Doll cart	The infant walking to support both hands in the cart and taking the "doll" in the cart	Padding the "handle" of the cart on the affected side	Keep both sides the same
Pulling a cart	Plastic carts	Pulling the cart	Pulling by hand	Pulling with a cord slightly tied in the affected hand and progress without any cord

*Grapes without seed.

daily information about the importance of motor experiences by the child, as well as bimanual exploration. Caregivers received guidance on bimanual practices performed in the home environment and the encouragement they should provide to the infant on the manual use of the affected limb.

2.4 Data analysis

The data were entered into the EXCEL 2013 program and a descriptive analysis was performed between continuous PEDI scores and AMIGO raw scores at three different moments, pre and post-intervention and follow-up; and the Trusted Change Index - TCI, using the Jacobson-Truax method (DEL PRETTE; DEL PRETTE, 2008). The Jacobson - Truax TCI is an alternative analysis for studies with small numbers of participants, the absence of normative and control group data that hinder inferential analysis of results based on measures of central tendency and dispersion (DEL PRETTE; DEL PRETTE, 2008).

3 Results

Five infants with LL asymmetry participated in the study, 3 were girls and 2 were boys. Four of them were diagnosed with CP and one with OBP. Table 3 shows the characteristics of the participants and their family unit.

The 60-minute daily sessions were organized and divided into 3 parts:

1) Preparation/Adaptation (5-8 minutes): The objective was to address the critical primary deficiencies of the systems, to increase the

Table 3. Characterization of participants and caregivers.

Participants; gender; chronological age	Diagnosis	Main Caregiver	School level	Age	ABEP (ASSOCIAÇÃO..., 2015)
P1 - male; 18 months	Bilateral spastic hemiparesis CP, GMFCS E & R– IV; Mini-MACS – IV	Grandmother	Incomplete Elementary School	41	Class C2
P2 – female; 20 months	Spastic hemiparesis CP, GMFCS E & R– I; Mini-MACS – II	Grandmother	Complete high school	38	Class B2
P3 - female; 20 months	Stroke, spastic hemiparesis, GMFCS E & R- I; Mini-MACS – I.	Mother	Complete elementary school	19	Class C2
P4 - female; 6 months	CP, spastic hemiparesis, GMFCS E & R- III; Mini-MACS - III	Mother	Complete Higher Education	24	Class B2
P5 - male; 15 months	Brachial Plexus Injury; Mini-MACS - I	Grandmother	Incomplete Higher Education	46	Class C2

success of the execution of the movements recruited in the activities. For this, passive global movements and stretching of the spastic muscles were performed. The movements and stretches were not restricted to UL since the infant uses the trunk and lower limbs in association with the upper limbs to perform a large part of the age-appropriate activities, which include gross motricity (crawling, touching feet, rolling, etc.);

2) Simulation (40 minutes): Through sensory and motor activities (focusing on the development of fine and gross motor skills) that simulate the desired functional objective, using shaping (part of the task - training method in which the task is gradually difficult in small steps by successive approximations) and the task as a whole;

3) The practice of most interest functional ability (12-15 minutes). The choice of tasks was related to some ability that the infant had delayed, that is, that he should have already acquired or he was of childbearing age, especially those related to playing, self-care and mobility. Caregiver interest and complaints were also considered.

The glove was placed at the beginning of each session and withdrawn only at the end. After the preparation/adaptation, the applied intervention started with sensory activities (placing the affected limb in a container with colored and gelatinous balls, touching objects and/or mats with different surfaces, drawing with gouache paint) and continued with gross motor activities (reaching in a four-position, sitting or standing, making it easier to perform transitions and reach the other position, grasping moving objects to work the balance in the posture), and finally, activities that require coordination and fine motor skills (draw with crayons, pick up foods like beans, put pins on a board, assemble a tower with blocks of varying sizes and feed).

The tasks and activities performed during the sessions were chosen according to the capacity and the need of each infant and changed frequently to maintain interest and motivation, so each one remained for a maximum of 10 minutes in each activity. A database of activities categorized by 2 domains was developed: scope and grasp domain; and manipulation of objects (Tables 1 and 2, respectively).

The toys chosen were colored and, whenever possible, with some sound, and various textures. These details have been carefully chosen to stimulate all aspects of motor development (gross, fine and balance motor), associated with the integration of visual, tactile and auditory information.

Positive reinforcement was offered in the execution of each proposed task and in any progression made to fulfill the behavioral techniques proposed by the CIMT, including the use of rewards such as predominantly verbal praise, smiles, hugs, applause, and clapping. Failures and unsuccessful tasks were not valued and the use of the affected limb was encouraged throughout the session.

Patients who underwent physical therapy and occupational therapy had their usual treatment during the application of this protocol.

The results of the evaluations measured in the pre and post-intervention, as well as, after 4 months of the end of the intervention (follow-up) are presented in Table 4.

The TCI analyzes the reliability between the measures, considered reliable and positive when it exceeds 1.96. For the calculation of this analysis, the standard deviation of the pre-intervention data of the sample included in the study was considered (DEL PRETTE; DEL PRETTE, 2008).

In the results of the PEDI, in the self-care section, P4 and P5 did not present a reliable index of changes between the evaluations for the group studied, although the two participants also presented significant improvements in their performance with final scores higher than the initial ones.

P3 and P5 did not present a reliable index of change in the results obtained by the PEDI - social role, although they showed an improvement of 0.8 in the continuous score of this instrument.

In the AMIGO, the P4 was the one that presented the least changes in the evaluation of the manual function, although its score went from 20 to 24 points.

4 Discussion

Of all the disorders caused by hemiplegia evidenced by the involvement of one or two body hemispheres (one being more subtly affected), the change in manual function is the most disabling (SKÖLD; JOSEPHSSON; ELIASSON, 2004). In addition to the motor ways, sensory impairment may interfere with the performance of fine motor skills (GORDON; DUFF, 1999). Consequently, there are impairments in typical motor development of the extremities and in the independence of manual skills (HIMMELMANN et al., 2006). Thus, many hemiplegic children use only the unaffected limb to perform tasks that are usually performed manually (CHARLES; GORDON, 2006).

According to a systematic review about the therapeutic approaches used to improve the motor actions of children with asymmetry of UL, CIMT and HABIT demonstrate effectiveness in the improvement of upper limb motor function affected and bimanual coordination (NOVAK et al., 2013).

Most of the studies with children use modified protocols of the CIMT to increase the tolerance and adhesion of the infantile population to the treatment (CHARLES; GORDON, 2005; GORDON; CHARLES; WOLF, 2005; PAGE et al., 2001, 2002). In the literature, there were several changes in the original protocol for the infant population, which differs between the time and intensity of the application, the time and type of restriction

Table 4. Results of pre, post-intervention and follow-up evaluations.

Participant	Evaluation	Pre	Post	*Follow-up*	TCI (pre e post)
P1	PEDI self-care	27.02	35.31	32.74	3.47
	PEDI Mobility	6.97	11.38	14.24	2.17
	PEDI social role	34.24	37.01	40.60	2.50
	AMIGO	2	10	7	2.82
P2	PEDI self-care	49.34	55.05	55.76	2.39
	PEDI Mobility	45.26	56.26	58.20	5.42
	PEDI v	47.45	50.02	51.67	2.32
	AMIGO	30	38	38	2.11
P3	PEDI self-care	37.68	46.24	49.34	3.58
	PEDI Mobility	36.80	46.67	51.94	4.86
	PEDI social role	47.45	48.32	50.02	0.78
	AMIGO	26	32	34	2.11
P4	PEDI self-care	35.31	39.85	52.94	1.90
	PEDI Mobility	6.97	14.24	27.85	3.58
	PEDI social role	24.85	29.16	47.45	3.88
	AMIGO	20	24	26	1.41
P5	PEDI self-care	43.69	44.57	49.34	0.37
	PEDI Mobility	48.11	52.76	51.94	2.29
	PEDI social role	46.56	47.45	49.18	0.80
	AMIGO	17	31	34	4.93

adopted and the organization of the sessions (NAYLOR; BOWER, 2005; CHARLES et al., 2006; CHARLES; GORDON, 2007; COPE et al., 2008; DELUCA et al., 2003; DICKERSON; BROWN, 2007; ELIASSON et al., 2005; FERGUS et al., 2008; GLOVER et al., 2002; GORDON; CHARLES; WOLF, 2006; MARTIN et al., 2008; KARMAN et al., 2003; KUHNKE et al., 2008).

Regarding the time of application, HABIT proposes a 6-hour daily practice (GORDON et al., 2007), while the CIMT elutes 2-hour sessions (ELIASSON et al., 2005; GLOVER et al., 2002) at 6 daily hours (DELUCA et al., 2003). The studies with children differ in intensity and duration of the intervention between 1 hour per week during 18 months (FERGUS et al., 2008) to 30 hours of intervention per week for 3 weeks (DELUCA et al., 2003). The choice of the intensity of this study was based on the demonstration of the efficacy of the CIMT method in children with hemiparesis, using a 2-hour daily intensity (ELIASSON et al., 2005; GLOVER et al., 2002). As this study included individuals with even earlier ages and considering the great age-related brain activity that makes neuroplasticity possible (GRANTHAM-MCGREGOR et al., 2007), this study proposed intensity of 1 hour daily, totaling 5 hours per week for 4 weeks.

The restriction of the functional upper limb is fundamental to the original technique of the CIMT (MORRIS; TAUB; MARK, 2006). However, restricting the unaffected limb can generate frustration in the patient, as well as not working transfer and protection activities in the falls (GORDON et al., 2007).

Regarding the type of restriction, this study used a removable glove made of neoprene tissue with extension up to the middle of the forearm, a restriction similar to those used in the studies of Coker et al. (2009) and Fergus et al. (2008), who carried out case studies, and Smania et al. (2009), who studied children aged 1 to 9 years old. Other researchers chose neoprene splint (LOWES et al., 2014), hard plastic (DICKERSON; BROWN, 2007; ELIASSON et al., 2005), plaster (LOWES et al., 2014), fiberglass (DELUCA et al., 2003, 2006; TAUB et al., 2004) or soft containment of an adult (NAYLOR; BOWER, 2005) as a form of restriction. The restriction length of these studies extends from the hand to the shoulder. Infants did not show irritability when using the glove and did not show signs of restriction stress.

In this way, the removable glove allows for freedom of movement of the shoulder, elbow, and wrist, allowing work transfer, laterality, and fall protection. With the glove, only the selective movements of the fingers were restricted, encouraging the fine motor development of the affected hand that collaborates with the tasks of daily life. Also, the non-affected hand can reach the toy even when activities are being directed at the affected member, providing bimanual experiences and acting as support.

Another variation was in the participation of caregivers. In the original protocol, a set of behavioral methods is applied that transfers the abilities conquered in the clinical environment to the real environment. For this, home-oriented tasks are recommended (TAUB, 2012).

In this study, it was decided to adapt the set of behavioral methods, with no mandatory household task, because there was no way to guarantee that all families would provide the stimuli appropriately, since there was a diversity among the participating caregivers regarding the availability of time with the child, school instruction or financial resources. If a family fulfilled the predetermined activities and others did not, there would be bias in our results. However, caregivers encouraged the manual use of the infant at home and not to reprimand him for difficulty or failure in a particular function or task. Other studies available in the literature did not involve parents in specific and controlled tasks (TAUB et al., 2004; DELUCA et al., 2006; SMANIA et al., 2009).

Regarding the activities chosen, the treatment included tasks that promoted increasingly complex levels of performance using the affected extremity. At each new skill, progression methods were used to increase the demands for greater accuracy, strength, fluency, automaticity and/or functional versatility. The ultimate goal was for the child to perform spontaneous self-initiation of movement with the affected limb and to use both hands together. The objects used to perform the tasks had attractive features with many colors, sonorities, and textures, providing sensory and motor experiences. The toys and materials were carefully chosen considering their inherent utility, the interest of the infants, and the motor strategies they could provide.

According to Carr and Shepherd (2008), the choice of materials used in clinical practice should elucidate changes in motor behavior and arouse interest in the patient. Moreover, according to the theory of Affordances proposed by Gibson (1986), the objects offer possibilities of interaction with the individual, able to awake, in a considerable way, through its characteristics and purposes, patterns of movements that act positively in the motor performance.

Regarding the TCI analysis, the standard deviation identified was high, since the sample studied is considered highly heterogeneous, since they differ greatly in terms of functional capacity, either by age or severity of the lesion.

There were small changes in the social function of all participants, but they were not identified by TCI in two of them (P3 and P5). The intervention protocol worked the social function through interaction skills such as bye, kiss, among others, associated with motor rehabilitation of the upper limbs. The two children (P3 and P5) already had several interaction abilities and already started from a higher score, presenting no evident difference between the evaluations.

Therefore, all the infants involved in this study demonstrated a greater amount and quality of movement of the affected limb, developed new behaviors, including gross motor movements, improved distribution and weight support of the UL and trunk, greater precision in palmar grip, improvement in social function with increased gestures and greater independence in self-care. Parents also noted a decrease in spasticity of the hand and reported that at rest, the infant's hand became more relaxed. These changes were observed both in clinical evaluations and in parental perception.

5 Conclusion

This study allowed to explore the great plasticity of the young brain, considering that treatment at an early age positively influences the motor sensory development of infants with lesions in the nervous system, since, therapeutic interventions at critical periods during the developing brain maturation ensure greater efficacy at earlier ages. The protocol was modified regarding the intensity, restriction, and the use of age-appropriate toys and activities, promoting motor and sensory activities with progressive skills levels. The tasks followed the replication model proposed by the original protocol and there was family-centered care based on information and guidelines. As a result, all infants improved in the spontaneous use of the affected limb increasing movement quality and improving abilities performed in single and bimanual tasks.

This study presents limitations due to the size of the sample, not allowing the formation of a control group and heterogeneity to be compared between asymmetric patients difficult. It is a challenge to perform an early intervention with infants with CP, since this diagnosis is made more frequently at 19 months old (MCINTYRE et al., 2011), and unilateral lesions do not necessarily lead to unilateral CP (HUSSON et al., 2010). Also, 80% of OBP cases present spontaneous recovery in the first months of life (MOLLBERG et al., 2005), and it is difficult to recruit infants diagnosed at such an early age.

However, through the results presented in this study, intensive care intervention protocol is a useful tool in the rehabilitation of asymmetric infants who have central or peripheral lesions. Although it is a preliminary study, it is an important contribution to care for infants with asymmetry, qualifying and expanding the technical and scientific knowledge of the professionals in the field, and suggesting the replication of the study in a larger sample, following the details of the sessions and the protocol here elaborated and analyzed.

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