CASE REPORT

Five oriented tasks in manual skills of a baby child with obstetric brachial plexus palsy

Paula Reis da Silva[1], Laís Rodrigues Gerzson[1], Carla Skilhan de Almeida[1]

ABSTRACT

Brachial plexus (BP) injury during labor is called obstetric brachial palsy (OBP). It is an abnormality that occurs in the upper extremity of the body due to excessive stretching of the neural roots of the BP. Every motor skill that the child with OPB acquires will be hampered by the deficiency in the movement of an upper limb (MS), impacting his motor experimentation. To modify their motor behavior, task-directed therapy can contribute to the function of the affected upper limb, because it is characterized by a protocol of functional exercises, which is still scarce in researches aimed at this morbidity. The objective of the study was to evaluate the effect of a motor intervention by means of five directed tasks on the manual skills of the upper limb of a child with OBP, as well as on his gross motor function. The child in the study was 17 months old, with left OBP, with weakness of shoulder abduction, external rotation, elbow flexion and wrist drop. He underwent 24 physiotherapy sessions with directed tasks for 45 minutes, three times a week. The Manual Ability Classification System (MACS) was used to classify the degree of severity of the MSE. The Gross Motor Function Measure (GMFM-66) quantitatively measured motor and static aspects and the Gross Motor Function Classification System (GMFCS) was used to determine which level best represented the abilities and limitations in the child's gross motor function. The targeted tasks were based on the model of the Induced Constraint Therapy (ICT) protocol, being: find the surprise; orange spoon; hair elastic fitting; fishing for bottle caps; stacking blocks. In the post-intervention assessments, the MACS showed improvement in the tasks of finding the surprise, orange spoon, and fishing for lids, but remained the same in the level of the activities of fitting the rubber bands and stacking the blocks. The GMFM-66 obtained an increase in the final score and the GMFCS remained at the level I. The GMFM-66 showed a 4.99% improvement at the end of the intervention. The activities finding the surprise, picking oranges, and fishing for bottle caps showed an improvement in the MACS level classification compared to the initial assessment. The findings show better muscle recruitment, with refinement in elbow flexion movements, forearm supination and external rotation (ER) of the shoulder.

Keywords: Neonatal brachial plexus palsy, Brachial plexus, Physiotherapy, Rehabilitation.

1. Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, (RS), Brasil

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INTRODUCTION

Brachial plexus (BP) injury during birth is called obstetric brachial palsy (OBP). It affects the upper limb (UL) and may result from stretching the nerve trunks or radicular avulsion of the BP during birth. It is difficult to determine the prognosis of this child, because the paralysis may be transient or definitive, interfering with motor and sensory issues[1]. This injury is classified as it affects the nerve roots of the upper trunk (C5-C6) of Erb's palsy, with decreased shoulder abduction, external rotation (ER), elbow flexion, and forearm supination. Distal (C8-T1) Klumpke's palsy mainly affects the forearm and hand[2], and total or Erb-Klumpke's palsy (C5-T1) affects all the roots of the BP.

These musculoskeletal changes affect the functions of daily living (ADLs) such as feeding, playing, reaching, and picking up objects in the short, medium, and long term[3]. From the biopsychosocial perspective[4], it is observed that the child will have limitations in his participation. It can affect personal factors and environmental factors[5]. Thus, it is necessary to promote these activities with intervention as early as possible[5].

A systematic review[6] described the best scientific evidence for intervention for children with cerebral palsy (CP), using the GRADE system and complementing it with the traffic light system (Evidence Alert Traffic Light System). In this study, the use of task-directed therapy in children with unilateral CP[6,7,8] was measured as green, which indicates a high level of evidence[6]. However, few studies have addressed task-oriented therapy specifically in OPB[3]. Some studies show evidence when treating children with PBO[1] sequelae with early intervention[9,10] and induced restraint therapy (ICT)[11], but not with the directed task.

Directed task therapy is characterized as a protocol of functional activities that aim to use the injured MS during training. This therapy provides sensory recognition, movement recovery, prevention of musculoskeletal dysfunctions, and upper limb (UL) integration during age-appropriate activities[12]. With the help of neuroplasticity, new neuronal connections are formed, through active and repetitive exercises, learning the movement with the injured upper limb[13]. The benefits of this therapy are related to motor learning principles, repetitions, result and performance feedback, cognitive strategies for attention, child motivation, and a stimulus-rich environment[7].

OPB compromises the MS, requiring the child to make a greater effort to perform the ADLs during their neuropsychomotor development, performing movements by means of muscle compensations, leading to not only a biological, but also a psychosocial change. There are few studies with this population and the use of the directed task. The objective was to evaluate the effect of a motor intervention by means of five directed tasks on the manual abilities of the MS of a child with OPB, as well as on his gross motor function.

CASE REPORT

A 17-month-old female child with a clinical diagnosis of *Erb-Duchenne* OPB of the left upper limb (LUL), did not use orthosis and had no other comorbidities. The diagnosis of the injury was clinical and was made by the orthopedic doctor at the maternity hospital where the child was born. He did not perform an electroneuromyographic exam, nor was repair surgery necessary. Since the first 15 days of life, the child was already being treated by physiotherapy, and presented weakness/paralysis of shoulder abduction, RE, elbow flexion, and wrist drop. After two months, he obtained a partial recovery of shoulder and elbow movement, with preserved passive range of motion, strength grade 4 for wrist extension, shoulder abduction, and elbow flexion, grade 3 for external rotation of the shoulder, resulting in a spontaneous recovery, which happens in more than 60% of the cases[14].

In a previous study, it was observed that there are specific scales to evaluate PBO, such as[15]: Active Movement Scale (AMS), Active Hand Assessment (AHA), Brachial Plexus Outcome Measure (BPOM), Children's Hand-use experience Questionnaire (CHEQ), and Set of Activities. At the child's age, only the AHA would be indicated, but it quantifies the degrees of the child's movements, whereas the Manual Ability Classification System (MACS)[16] emphasizes the functional description to classify the degree of MS severity. This classification system describes the best level of typical global performance at home, at school or in the community.

The child's motivation and cognitive ability also affect the ability to manipulate objects. With the MACS you can see the evolution of manual skills.

The levels are based on the child's ability to initiate manipulation of objects on his/her own and the need for assistance/adaptation to perform manual activities in ADLs: Level I: Manipulates objects easily and successfully; Level II: Manipulates most objects, but with reduced quality and/or speed; Level III: Manipulates objects with difficulty; Level IV: Manipulates a limited variety of easily manipulated objects; Level V: Does not manipulate objects and has severely limited skills.

The Gross Motor Function Measure (GMFM-66) was used to measure the broad motor aspects. The GMFM-66 is a standardized, translated, and reliable instrument for assessing children from 5 months to 16 years. It consists of 66 items involving five dimensions: 1) lying and rolling; 2) sitting; 3) crawling and kneeling; 4) standing; and 5) walking, running, and jumping[17].

The gross motor skill estimator (GMAE) converts the GMFM-66 results into percentages, with 100% representing the maximum score. To verify an important change in the child's condition, a variable was created that calculates the minimal clinically important difference (MCID)[18], showing whether the intervention caused a change in the child's condition. So, since there is no MCID for OPB yet, it was used for CP (hemiplegia). The child was classified by the Gross Motor Function Classification System - GMFCS[17]. For GMFCS level I (the child's case) the MCID 1.7 to 0.5 confidence interval and 2.7 to 0.8 are considered. The GMFCS has five levels, where level I is the mildest and level V the child is most dependent[19].

The contralateral limb did not undergo any restraint during physical therapy; however, the directed tasks were based on the model (shaping) of the TCI protocol. Tasks were performed in a repetitive and intensive manner, promoting their facilitation, treating the basic components of movement[7].

The following activities 7,8 were developed (Figure 1): a) Find the surprise - seated - six glasses 11 cm high and 7 cm in diameter were placed with the rim down on a table 36 cm high, where he should find the three toys hidden under the glasses; b) Pick oranges - standing in front of a tree 110 cm high - he took six little balls attached with Velcro and placed one at a time in the bucket 24 cm high, positioned next to the child; c) Fitting hair elastics - standing - fitting 4 hair elastics on pins with diameters of 3 cm and height of 48 cm; d) Fishing for lids - standing with a sieve - fishing for four lids in a basin 36 cm high from the ground, with water, and putting them in a bucket at a distance of 18 cm from the ground; e) Stacking blocks - standing - building a tower with five large blocks on a table 36 cm high.

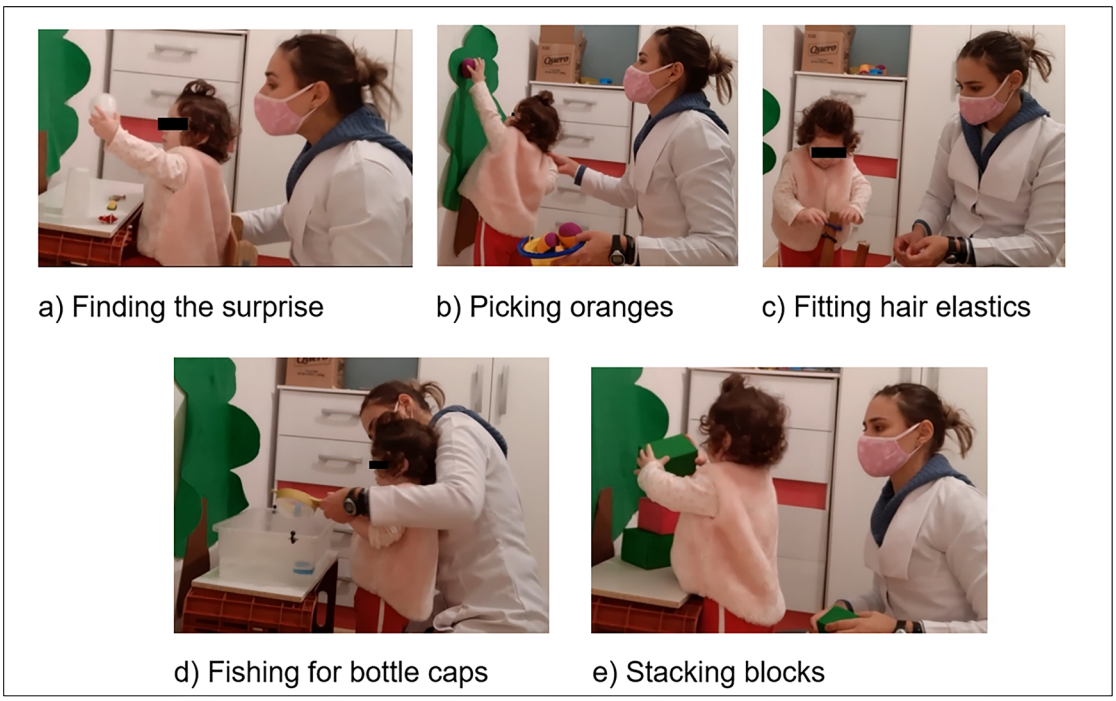

Figure 1. Five directed tasks performed in the 24 sessions.

As the child reached the goal of the activities, progressions were made regarding their posture, size and weight of the cups and blocks, the resistance of the rubber bands, and positioning of the bucket. The tasks were timed to analyze if there was a decrease in time during the sessions. Each task was performed twice, for a total of 35 minutes all tasks (on average).

Initially, parents were given a questionnaire about the participant's clinical characteristics and routine. Data collection was carried out in 45 minutes, there were 24 interventional sessions, three times a week. This level of intervention was defined based on studies that performed 15 interventional sessions with positive results[7,8]; however, our research carried out more sessions to promote more gains in the child's activities, 18 hours of training in total, where the recommendation should be a minimum of 14 to 24 hours in cases of CP[20]. The child performed active and passive stretching, and then the directed tasks. If the child showed any irritation or crying, the task was paused. Only one session was rescheduled, because the child was ill. The sessions were filmed, with anterior and lateral views, with a tripod 30 cm from the floor in a previously studied position to facilitate filming the sessions.

The evaluation was performed through videos by a blinded evaluator. The filming helped in the subjective analysis done by video referring to the shoulder, elbow, forearm, and hand joints, and motor coordination during the proposed activities. The stages of the session were evaluated, the tasks used, the execution time of each one, the specific body segments, and the number of exercises performed each day. The results obtained were tabulated in an Excel spreadsheet. The GMAE was used to convert the GMFM-66 results and graphical representation of these scores.

The project was approved by the Comitê de Ética em Pesquisa (CEP) of the Hospital de Clínicas de Porto Alegre under opinion number: 4.041.470 (CAAE: 30671220.9.0000.5327). The person responsible for the child (who demonstrated during the sessions knowledge of the physiotherapeutic diagnosis of hypotonic monoparesis of the LUL and the child's prognosis) signed the Free and Informed Consent Form, agreeing with the participation of her daughter in the research.

The pre- and post-intervention results through the MACS and their progression over the course of sessions are shown in Table 1 and 2, respectively.

Table 1. Results of the MACS classification in each task performed with the impaired UL pre- and post-intervention

Directed tasks	MACS Pre	MACS Post
Finding the surprise	II	I
Picking oranges	II	I
Fitting hair elastics	II	II
Fishing for bottle caps	IV	III
Stacking blocs	II	II

MACS: Manual Ability Classification System; UL: upper limb

Although these have no statistical power, they are important in evaluating the child's evolution at the end of the intervention. Among the activities performed, the one of stacking blocks was classified as grade I in the MACS from the 10th to the 15th session, when observed by the videos; however, after performing the progression of decreasing the size of the blocks and removing the weight, its classification was changed to grade II, remaining this way until the end of the 24th session.

In the activity of fishing for bottle caps, it was only after the 6th day of intervention that the child was successful in the task of fishing, independently, when the child understood it. In the 13th intervention, there was a free active movement to perform this activity, showing more autonomy, motor coordination, and improvement in forearm supination movements. In the end, he actively performed the shoulder ER and forearm supination, performed elbow flexion, and stabilized the scapula, corroborating the medical evaluation.

The final score of the GMFM-66 showed an increase in its percentage from 60.01% to 65% (Figure 2). When comparing with the MCID, its difference was 4.99% (greater than 2.7), meaning an important change in the child's condition. There was an increase in the score related to the activity of moving from sitting on the floor to sitting on a large stool, where, in the initial assessment, she started the movement and, in the end, partially completed the activity; standing: holding on to a large stool with one hand, she raises her left foot keeping it for 3 seconds and then her right foot, in the pre-intervention she could not with her left foot and started the activity with her right foot and, after the intervention, she performed both activities completely.

Table 2. Descriptive classification of post-intervention activities, predominantly involved muscles, and expected and achieved progressions (descriptive results, evaluated according to the evaluator's perception).

Activities	Gain of Movements	Muscles Predominantly Involved	Expected Progressions	Realized Progressions
Finding Surprise	Elbow Flexion Elbow Extension Forearm supinator ER of shoulder Shoulder adduction	Bíceps brachii, brachiorradialis, brachialis; Triceps brachii; Supinator, biceps brachii; Infra- spinal, teres minor; pectoralis major (sternocostal portion), latissimus dorsi, and teres major.	Child's Position: Initially sitting, then standing; Decrease the height of the table with the cups when she remained standing; Decrease the diameter and height of the cups; Decrease the size of the toys, then increase the difficulty by sticking stickers.	Position of the child: Sitting, standing. Height of the table with the cups: 36 cm; 18 cm. Size of the cups: Diameter (7 cm) and height (8 cm, 9 cm and 11 cm). Hidden toys: Small toys; Stickers stuck to the bottom of the cups.
Picking Oranges	Elbow Flexion; Elbow Extension; Shoulder Flexion; Forearm Supinator Shoulder Extension ER of shoulder; Shoulder adduction	Biceps brachii, brachiorradialis, brachialis; Triceps brachii; Deltoid clavicular, pectoralis major (clavicular portion) and coracobrachial; Latissimus dorsi, teres major, pectoralis major (sternocostal portion); Supinator, biceps brachii; Infra-spinal, teres minor; pectoralis major (sternocostal portion), latissimus dorsi, and teres major.	Increase the child's distance from the tree; Increase the distance from the child to the bucket; then have the child hold the bucket with the uninjured arm during the activity; finally position the bucket with a greater distance. Increase the height of the bucket relative to the ground	Distance from the child to the tree: Straight ahead; 72 cm; 82 cm; 100 cm. Distance from bucket to child: Beside; 40 cm; 50 cm; next to it (holding it with an uninjured arm) and at the end placing the bucket on a bench with 64 cm away from the child Height from bucket to floor: 18 cm; 48 cm.
Fitting Hair Elastics	Finger Flexion (Pincer) Shoulder Adduction	Superficial flexor of thumb and index finger, short flexor of thumb, short abductor of thumb, adductor of thumb, first palmar interosseous. Pectoralis major (sternocostal portion), latissimus dorsi, and teres major.	Reduce the thickness of the elastics with increased strength; Increase the strength of the elastic bands.	Elastic thickness: wide; narrow; very narrow. Resistance of the elastic bands: No, little, a lot. Variety of these characteristics during the sessions.
Fishing for bottle caps	Forearm Pronation Forearm Supination	Pronator Quadratus; Supinator and biceps brachii.	Increase the distance from the bucket to the ground; Decrease the size of the basin; Diecrease the size of the sieve.	Distance from bucket to floor: 18 cm, 35 cm. Basin size: Large; medium. Sieve size: medium
Stacking Blocks	Elbow Extension Shoulder Adduction ER of shoulder	Triceps brachii; Pectoralis major (sternocostal portion), latissimus dorsi, and teres major. Infra-spinal, teres minor.	Child's position: Initially standing, then sitting; Increase the weight of the blocks: Initially large blocks without weight, then with weight; Reduce the size of the blocks offered: initially large, then small. Decrease height: height of the table with the blocks.	Child's position: Standing; sitting. Block weight; Without weight; with weight Block sizes: Large; Small; Table height: 36 cm; 18 cm; without table

ER: external rotation; cm: centimeters

Item Number	Assessment Date	Age	GMFM-66 Score	Assessment Type	Standard Error	Lower	Upper	Items Tested	GMFCS Level	Therapist	Change Score
1	28 Maio, 2020	1y 5m	60,1	GMFM-66	1,2	57,7	62,5	66	Level I	Paula Reis da Silva	N/A
2	5 Agosto, 2020	1y 8m	65,0	GMFM-66	1,1	62,2	67,7	66	Level I	Paula Reis da Silva	1,9

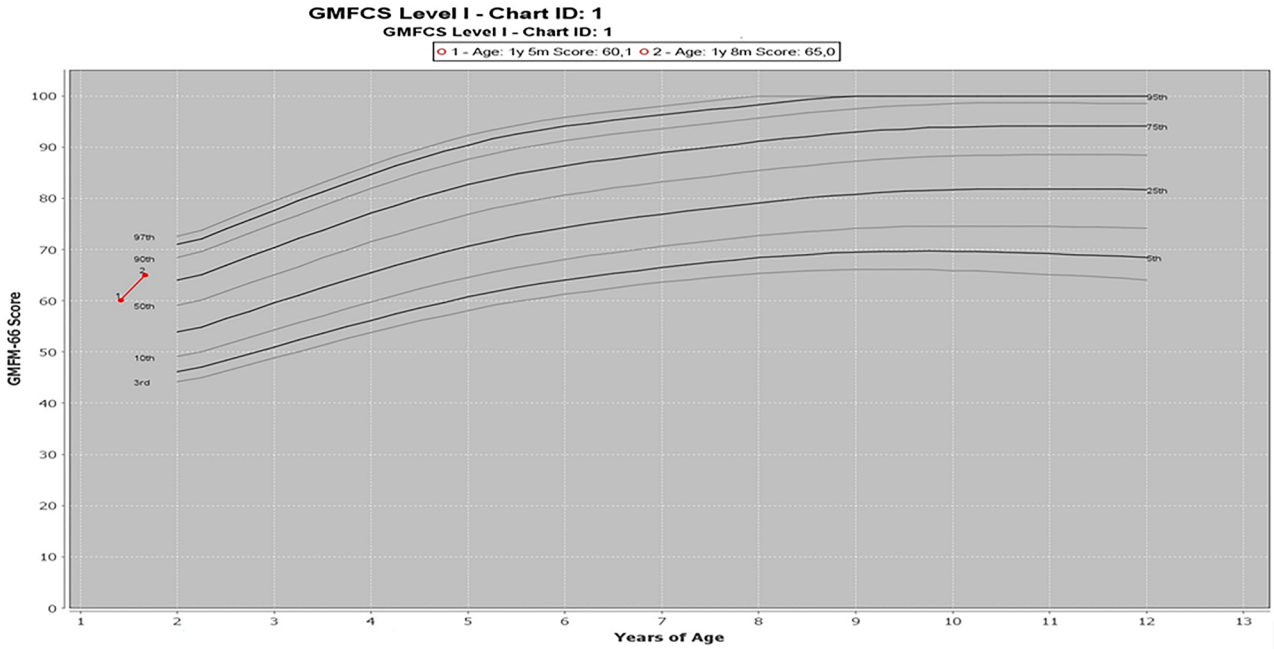

Figure 2. GMFM-66 and GMFCS pre and post-intervention.

In some activities, the child did not initiate any of them, but after the intervention, he started to initiate these tasks. In the activities of lifting the left and then the right foot with arms free for 10 seconds; transposing a stick positioned at the knees' height, starting with the right foot and then the left, the child in the first evaluation did not initiate these activities, due to lack of balance and safety, as well as jumping 30 cm high with both feet and forward with both feet. In the final evaluation, the child was able to start these activities since he presented better movement and confidence with the upper limbs, in case he needed to hold on to avoid falling.

DISCUSSION

The great differential of this study, even though it is a case report, was to study the use of task-directed therapy in a child with PBO[3], since there are more studies with CP[6]. Another important situation, also studied with children with CP, was the therapy time. Jackman et al.[20] recommend a time of 40 hours of task training for MS. However, gains have been seen in a minimum time of 14 to 24 hours. In this study, 18 hours of intervention were conducted, which already demonstrated an improvement.

Regarding the deficits resulting from neural lesions at the beginning of the interventions, we identified a decrease in the function of some muscles (such as the biceps brachii, deltoid, and RE) directly related to the lesion in the PB that innervated them[13]. This sequence of impairments triggered changes in limb kinematics[2]. The more specific the training, the more visible the gains will be[6]. The task-oriented training helped muscle strengthening, since during the rehabilitation process muscles and nerves are in full recovery[1]. The movement provided the acquisition of age-appropriate skills, promoting the active movement of muscles during the exercises, helping the child's insertion in context-oriented activities, corroborating previous studies[2,13]. In the development of motor control over the interconnected segments of the upper limb, impaired individuals need to recover the ability to combine their motor performance in front of objects within their context. She coordinated the actions of agonist and antagonist muscle groups, instituting greater harmony in the movement. Thus, while the child was performing the activity of finding the surprise, for example, she was helped to perform forearm supination to look under the glass.

There was a lower degree of RSM severity assessed by the MACS during most of the proposed activities at the end of the sessions. There was an increase in the grade level in three activities (finding the surprise, picking oranges, and fishing for bottle caps), even though progressions in difficulty levels were applied. On the other hand, two activities did not show this increase in the final rating grade when compared to the first day of intervention, possibly because the child kept performing the activity with the imposed progression, since these were performed whenever the child achieved the desired movement and acquired a new skill, thus aiming to improve the performance of the tasks[3]. The most significant aspect was the possibility of implementing the progressions expected and achieved in the five tasks, which contribute to the child's evolution. And this should be said to him and his family, because the progression may give the impression of worsening performance, but it is part of the recovery process.

The intensive task-related training helps to control muscle strength and the coordination of limb segments[8]. Although the child increased his MACS classification level only in some activities in the final evaluation, the increase in coordination and functional independence evaluated qualitatively is evident. Zielinski et al.[21] reported that PBO benefits from bimanual training. In this study, the directed tasks also caused the bimanual work, consequently, there was a better performance in the use of hands in ADLs, as reported by the mother at the end of the study in the post-intervention questionnaire. The more the exercises are similar to the routine, more reorganization will occur when facing the proposed task. Activities related to balance, strength and coordination may facilitate even more the target muscle, the strength generated and the refinement in their functional abilities[8].

There was greater use of upper limbs to perform the tasks, confirming that the targeted tasks promote an increase in the ability, dexterity, and control to reach and hold objects[8], as well as improved the broad motor development of this child. The increase in the GMFM-66 score after the interventions is due to the child's ability to perform some items, evolving from not starting, or just starting without fully completing. The score increase after the interventions was 4.99% in the GMFM, which represents that the gain was related to training and not to the child's natural chronology. The child started to perform gross motor activities that he did not do in the first evaluation, and improved their execution, which shows better functional ability, especially in items related to sitting and standing. But the intervention cannot be seen only as an improvement in body structures and functions. The vision must be global; we must always see the child in the biopsychosocial factors [4,5].

As a limitation of this research, the data is exclusive of the child evaluated; therefore, it cannot be generalized. More specific tests for diagnosis were not done, only clinical ones, such as the electroneuromyographic exam. The electroneuromyography would accurately indicate the evolution of the process. Also, there were sessions in which the child was not cooperative during all the activities, due to sleepiness and/or tiredness; however, only one session needed to be rescheduled because the child was ill. Further research with more subjects is suggested to identify its effectiveness and apply instruments to evaluate the context. It was not possible to measure environmental, biological, and task aspects, which may have interfered with these items.

CONCLUSION

The effects of a motor intervention through five directed tasks on the manual skills of the upper limbs of a child with PBO improved the manual skills of the case studied under a scientific perspective; with the strengthening of the SSM muscles, better coordination and greater harmony in movement. There was greater use of the upper limbs to perform tasks, greater dexterity and control to reach and hold objects. The use of task directed, even if specific, improved the broad motor development.

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Corresponding Author:
Carla Skilhan de Almeida
carlaskilhan@gmail.com

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