

The efficacy of physical therapy on the improvement of the motor components of visual attention in children with cerebral palsy: a case series study

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This paper has attempted to compare the effects of Bobath's concept with control's session on the improvement of visual attention in children with cerebral palsy. A 10 children sample (7 girls and 3 boys) aged 6 to 16 years (median, 12 years) was collected. The group who had received Bobath-based treatment crossed-over to control treatment and the previous control group received Bobath-based treatment for once a week. Measures were assessed at pre- and posttreatment. Outcome measure included the visual attention, we used Conners' Kiddie Continuous Performance Test (K-CPT). Bobath's session targeted to crossed-

over participants produced greater improvements in K-CPT(RT) (difference=33.1, $P<0.05$) at posttreatment compared to the control's session group, whereas the improvement of K-CPT did not differ between groups. The results of this case series study showed a significant improvement on visual attention through the improvement of motor control functions after the Bobath's session over the control's session.

Keywords: Cerebral Palsy, Bobath's concept, Neurodevelopmental treatment, Visual attention

INTRODUCTION

The motor disorders of cerebral palsy (CP) are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behavior, and/or by a seizure disorder (Bax et al., 2005). Considering the CP from a clinical point of view we can classify it following two different criteria: considering its highly heterogeneous clinic symptoms and considering the number of affected limbs. One of these with high incidence are *visual disorders* that appear on some children with CP and have a big impact in many everyday functions.

Regarding visual alterations and CP, Hesse et al. (1998) informed that the prevalence is around 50%, considering the available studies, and 7%–9% would be several visual alterations. Sal'kov et al. (2011) informed that visual alterations showed by children participated in their study were, ocular movement and coordination dis-

orders, oftalmoparesis, horizontal nistagmus, strabismus, convergence problems and visual acuity deficits. In the future, vision impairment will have an impact on dynamic walking stability (Lim et al., 2017). One treatment approach for movement and posture disorders is the Bobath's concept or neurodevelopment therapy due to central neurological injuries, and it's founded on the principles of neural plasticity, brain damage consequences and abnormal movement and posture patterns.

Many study due to analyze therapy's results by comparing pre and postintervention results have a common methodological ground as they used self-reported test. Tsorlakis et al. (2004) used instrumental techniques to determine the therapy effects on hemiparesis patient's gait. They found some significant improvements on several gait parameters after intervention. There are some studies including children that compare Bobath with other therapies like AMIE (acupuncture, massage, injection, and exercise) therapy

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(He et al., 2007) that did not find statistically significant differences after 60 treatment sessions. About the measure instruments, there are some reports about Conners K-CPT test. Pirila et al. (2011) informed 53% prevalence of attention deficit hyperactivity disorder (ADHD) potential diagnostic children on their 17 children with CP sample.

In conclusion, Bobath therapy effects on brain damage derivative dysfunctions have been more explored in adult population (Antunes et al., 2017; Puce et al., 2018). However, its effects on children are not sufficiently defined. On the other side, the relation between any intervention based on physical therapy principals and visual and attentional functions remains as an uncover topic.

For that reason, the aim of this study is to explore the benefits of Bobath therapy on children considering visual and attentional functions.

MATERIALS AND METHODS

Design

We conducted a case series study (approval number: 060520-165416). Informed consent was obtained from all children and procedures were conducted according to the Declaration of Helsinki. Previous authorization was obtained from each of the participating centers, meeting the ethic criteria of each one of them. As the children did not leave the schools facilities neither for the assessment or the intervention, the school board was in all moment the maximum responsible for the adequacy of the study to the local legislation.

Sample

A sample of 10 children (7 girls and 3 boys; aged 6 to 16 years) from special educative needs schools was collected. Previous authorization was obtained from each of the participating centers, meeting the ethic criteria of each one of them. As the children did not leave the schools facilities neither for the assessment or the intervention, the school board was in all moment the maximum responsible for the adequacy of the study to the local legislation.

Inclusion criteria

- Children from 4 to 16 years old with tetraplegic CP diagnostic.
- Cognitive development age higher than 4 years.
- GMFCS-E & R score equal or higher than III.
- Informed consent signed by their parents or legal tutors.

Exclusion criteria

- Have a several visual disorder associated to CP that would not allow the performance of the visual attention test.

Variables and measurement

The predictor variable is that Bobath's concept treatment (I) vs. nonneurological approach control treatment (C), the dependent variable is visual attention.

Measure used Conners's Attention test for Children KCPT (Abuin-Porras et al., 2018) and The Gross Motor Function Classification System (GMFCS) (García et al., 2016) for CP. KCPT is a computerized test designed to diagnostic attention disorders in children, provides an estimation index of ADHD diagnostic (it uses a 0%–100% risk scale).

We are using this to measure visual attention ability. We are going to used reaction time (Stimulus-Response interval in Kiddies Conners Test) (RT) and Omission error in Kiddies Conners Test (OM) as a measure of visual attention ability. GMFCS It is based on self-initiated movement, with emphasis on sitting, transfers, and mobility. The primary criterion to define a five-level classification system was that the distinctions between levels must be meaningful in daily life. ADHD diagnostic and motor control function skills are mediator variables.

Procedure

All the children have received both treatments, Bobath and nonneurological approach control treatment. After checking successfully the inclusion and exclusion criteria, we asked for the informed consent to children's parents or legal tutors. The procedure included three sessions, called A, B, C and shown in Fig. 1.

A, Initial evaluation, collection of personal data from the children (age, sex, diagnosis, visual conditions). Application of GMFCS to evaluate their motor control condition.

B, Control intervention (C),

- Conners's K-CPT application pre intervention: Results (KCPT-PRE-con-OM and KCPT-PRE-con-RT, ADHD, if necessary)
- Control intervention
- Conner's K-CPT application post intervention (KCPT-POS-con-OM and KCPT-POS-con-RT)

C, Bobath intervention (I)

- Conners's K-CPT application pre intervention: Results (KCPT-PRE-exp-OM and KCPT-PRE-exp-RT)
- Bobath intervention
- Conner's K-CPT application post intervention (KCPT-POS-

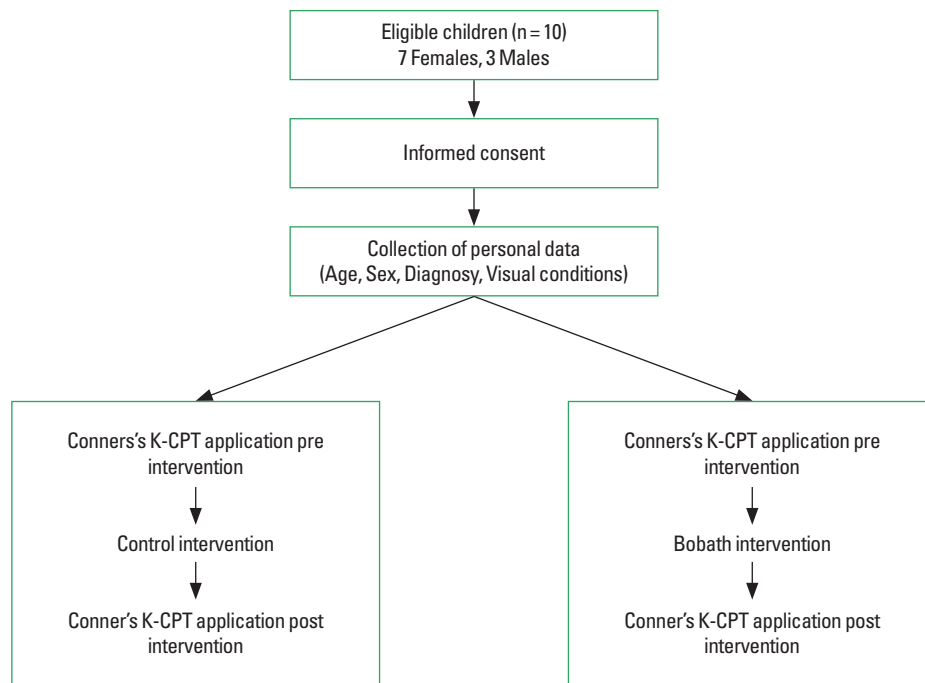


Fig. 1. Conners' Kiddie Continuous Performance Test (K-CPT): Conner's attention test for children.

exp-OM and KCPT-POS-exp-RT)

We randomly split the sample in two groups, to minimize possible bias due to training on the attention test (as the children would have performed the test once after or before the Bobath intervention). Half of the children's procedure was: Session A – Session B – Session C and the other half procedure was: Session A – Session C – Session B. There was a seven day lap between session B and session C in both procedures.

The C-Bobath intervention (I) session consisted on 45 min of treatment following basic principles of the Bobath concept treatment. Described in detail are:

- Reduction of the increased tone. To prepare the pelvic area for sitting position, slow rhythmic movements to reduce the spastic response.
- Training of trunk and head control in sitting position. According to the child's ability to maintain sitting position facilitation by the therapist was provided. The control was performed according to Bobath's concept treatment, and was variable depending on each child and was reduced during the progression of the session as the patients were able to perform better.
- Assisted weight-shifting from one hip to another while sitting. Patients should join with their heads the movement of the trunk.

- Assisted rotation of the trunk. Patients should join with their heads the movement of the trunk.
- Voluntary reach with upper limbs. If possible patients should maintain head and trunk stable during the perturbation due to self-initiated movement.

The control treatment consisted on stretching of the upper and lower limbs in a supine position.

Statistics

Data were analyzed using IBM SPSS Statistics ver. 21.0 (IBM Co., Armonk, NY, USA), conducted following an intention-to-treat analysis using the last value forward method. Normal distribution of the sample was analyzed by using the Kolmogorov–Smirnov test. A one-way analysis of variance with repeated measurements and Bonferroni was used as *post hoc* test to evaluate statistical significance. For all the data of the study, *P*-values lower than 0.05 were considered significant.

RESULTS

In the present case series, no subjects dropped out during the different phases of the study, and no adverse effects were detected after the application of the treatments. None of the subjects began drug therapy during the course of the study.

Table 1. Visual attention results compare OM and RT from K-CPT results between pre- and posttreatment measures

K-CPT result	Group				Difference within groups	
	Pre		Post		Post – Pre	
	Exp (n=5)	Con (n=5)	Exp (n=5)	Con (n=5)	Exp (n=5)	Con (n=5)
OM	19.8 (17.7)	24.3 (23.4)	27.5 (31.8)	28.1 (28.3)	7.7* (15.9)	3.8 (5.5)
RT	640.7 (143.9)	682.2 (172.5)	673.8 (186.1)	676.0 (213)	33.1* (96.9)	-5.7 (131.6)

K-CPT, Conners' Kiddie Continuous Performance Test; OM, Omission error in Kiddies Conners Test; RT, reaction time (Stimulus-Response interval in Kiddies Conners Test); Exp, experimental; Con, control.

*Significantly different within groups, $P < 0.05$.

Table 2. ADHD intergroup effects on visual motor control therapy effects

Variable	Group				Difference within groups	
	Pre		Post		Post – Pre	
	ADHD (n=5)	Non-ADHD (n=5)	ADHD (n=5)	Non-ADHD (n=5)	ADHD (n=5+5)	Non-ADHD (n=5+5)
Con group left	117.1 (67.9)	35.1 (40.6)	115.7 (67.7)	39.1 (59.1)	1.4 (1.7)	-4.0 (19.1)
Con group right	121.9 (68.4)	51.8 (38.6)	117.6 (67.4)	36.4 (38.5)	4.3 (6.0)	15.5 (22.7)
Exp group left	148.8 (39.7)	90.9 (63.0)	111.8 (56.7)	23.7 (21.4)	37.0* (18.2)	67.2* (50.9)
Exp group right	143.7 (43.4)	108.2 (57.0)	108.2 (57.7)	28.5 (30.7)	35.5* (34.7)	49.1* (54.9)

ADHD, attention deficit hyperactivity disorder (Stimulated risk of ADHD in Kiddies Conners Test); Exp, experimental; Con, control.

*Significantly different within groups, $P < 0.05$.

Response to treatment

Outcomes for K-CPT (OM) and K-CPT (RT) demonstrated a significant time factor ($P < 0.001$). The RT and OM increased for all participants after the treatment period. The *post hoc* analysis revealed significant differences between the twice sessions for the experimental group ($P < 0.05$) (Table 1).

In order to test ADHD effects we have divided the sample into two groups, ADHD (1) and non-ADHD (0), the grouping criterion was the ADHD diagnostics score from K-CPT. We had 5 children who had a score higher than 90% chance of having ADHD and five children who had a score far lower than that. So we analyzed the Bobath concept treatment vs. Control treatment comparison considering the ADHD diagnostic influence. The IRISCOM-exp left and right decreased for all participants after the treatment period. The *post hoc* analysis revealed significant differences between the two sessions for the ADHD group ($P < 0.05$) and for the not-ADHD group ($P < 0.05$) (Table 2).

DISCUSSION

In order to test the Bobath's concept treatments results over visual attention, we have compared OM and RT from K-CPT results between pre- and posttreatment measures. The results do show statistical significant difference in both variables.

Specific Bobath therapy in children with CP improves motor control. Our results match those found by Langhammer and Stanghelle (2003) and Platz et al. (2005) as they found statistically significant effects that supported Bobath therapy as an effective therapy procedure. More precisely, Langhammer and Stanghelle (2003) found a posture control improvement and that was related to weight symmetric distribution and balance control. Those functions are related to visual motor system. Additionally, Platz et al. (2005) showed some positive changes related to muscle tone, that will be in our sample one of the keys to obtain head control and increase visual attention ability. A more adequate muscular tone will facilitate the movements of the eyes concerning to head control against gravity.

Tsorlakis et al. (2004) and Knox and Evans (2002) found in their studies in children improvements in motor function after applying Bobath therapy, using as a measure the Gross Motor Function tests. There is a relationship with their results and ours, from the point of view of the anatomical connection between head and eyes explained by Ferrani. The improvement of the head control implies the betterment of visual attention through the improvements on the visual motor control. The ability to visual attention is important for many reasons, to various combinations with physical and speech disorders, which requires a differentiated approach and that as we have seen, those who have visual disorder

ders get less improvement of motor skills than those who have not. This makes us understand how much these children need a careful evaluation of visual disorders and then a special education, considering the need for a facilitatory context for learning.

From the ADHD perspective Silva et al. (2014) conclude, as well as we do, that there is a high ADHD prevalence, measured by K-CPT Conners' test, on children with CP. Additionally, they said that children with CP and tetraplegia are more prone to have attentional problems, since they have both brain hemispheres harmed.

This considerations support the Bobath's concept therapy as a valid instrument to improve visual motor control and therefore visual attention functions in children with CP, all this with a focus on the tiredness of the child. Considering also that improvement of the head control implies the betterment of visual attention through the improvements on the visual motor control.

Our findings confirm benefits that Specific Bobath therapy could have in children with CP, as we see, to improve visual motor control and therefore visual attention functions in children with CP, all this with a focus on the tiredness of the child. Further studies with largest samples should be carried to confirm this affirmation.

In our study we recognize that the sample size was small, although sufficient to determine significance and the lack of a control group. In our study we included all types of visual disorder, could result in different motor performance. It is important that future studies notice which type of visual disorder each included child has. It would necessary a more extensive intervention over time and sessions to test the permanency of the hypothetical changes.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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