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The Effect of Comprehensive Art Therapy on Physical Performance and Activities of Daily Living in Children with Cerebral Palsy

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Abstract

Purpose : To evaluate the effect of comprehensive art therapy on physical function and activities of daily living in children with cerebral palsy (CP).

Methods : Ten ambulant children with diplegic (n=8) or hemiplegic (n=2) CP participated in this study. All were randomly assigned to either the art therapy group (n=5) or the control group (n=5). Both groups received physical therapy based on neurodevelopmental techniques for 20 minutes a day, 1 day a week, for a period of 12 weeks. Children in the art therapy group received additional comprehensive art therapy for 70 minutes once a week for 3 months. Tests for various measurements—Motricity Index (MI) for strength, Trunk Control Test (TCT) for trunk ability, Gross Motor Function Measure (GMFM) and Gross Motor Function Classification System (GMFCS) for gross motor function, Denver Developmental Screening Test-II (DDST-II) for developmental milestones, Functional Independence Measure of Children (WeeFIM) for abilities to complete daily activities, Leg and Hand Ability Test (LHAT) for limb function—were performed before and after treatments.

Results : The upper extremity and whole extremity strengths of MI, self-care and total scores of WeeFIM, and leg and arm functions of LHAT improved significantly only for individuals in the art therapy group after the art therapy ($p<.05$). The value of MI after treatment was at the upper extremity and whole extremity strengths the leg function of LHAT was also significantly improved compared to the control group ($p<.05$).

Conclusion : This study revealed that comprehensive art therapy along with physiotherapy was effective in increasing upper extremity strength and leg ability in children with CP. This suggests that comprehensive art therapy may be a useful adjunctive therapy for children with CP.

Key Words : art therapy, activities of daily living, cerebral palsy, physical functional

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Ⅰ. Introduction

Art activity involves playfulness, creativity, symbolism, and improvisation, and brings benefits such as spiritual growth and alleviation of mental suffering. Hence, the application of art activities may improve quality of life (Omizo & Omizo, 1989). Specifically, the purpose of art activities for handicapped children with pain, frustration, and unsatisfied needs is to develop their potential in the sensory, psychological, and social developmental domains (Omizo & Omizo, 1989).

Cerebral palsy (CP), which is a group of disorders rather than a single disease, is defined as a primary abnormality of movement and posture, secondary to a non-progressive lesion in a developing brain. It actually represents abnormalities in motor control, tone, and sensory, cognitive functions, activities of daily living (ADL). They also often have developmental delays in motor skills (DeLisa et al., 2005). Rehabilitative intervention in children with CP is almost entirely focused on neurodevelopmental and skill components including muscle tone, reflexes, abnormal movement patterns, postural control, sensation, perception, memory, and ADL. Thus, a comprehensive approach to treating CP patients will include motor and ADL aspects.

Art therapy is firmly established as an important part of a complementary approach to the physiological and ADL problems of children with developmental disorders. Art activities allow children with disabilities the opportunity to grow gross and fine motor skills, and ADL skills through self-expression. During art therapy, participants commonly use their upper extremities art therapy is thought to induce motivation and improve the upper extremity's fine and gross motor function, and strength through repetitive joint exercise. Furthermore, art therapy develops ADL skills, and is helpful for people with disabilities. This may be due to the reduction of stress, which accelerates the general physical process. However, to our best knowledge, there are no studies observing the effects of art therapy on physical function, activities of daily living (ADL) and developmental process in CP patients.

This study is designed to evaluate the effects of art therapy on physical, functional, and daily living abilities in children with CP. Effects of comprehensive art therapy were investigated specific physical and motor functions (in terms of muscle strength, trunk mobility and balance, gross motor function and overall disability degrees and level of developmental process), ability to perform ADL, and motor capacity of upper and lower extremities.

Ⅱ. Methods

1. Participants

Consecutive ten children with CP, who were being treated in an outpatient clinic of rehabilitation medicine at a university hospital, were recruited. The following selection criteria were applied: (1) children were aged 4 to 15; (2) children had diplegic or hemiplegic CP; (3) children had the ability to walk a distance of 1 m or more independently; (4) children had level I or II in Gross Motor Function Classification System (GMFCS) (Palisano et al., 1997); (5) children did not have an operation during the last year or during the study, nor took chemo-denervation with botulinum toxin for the last 6 months; (6) children had visual, cognitive, or behavioral impairment; (7) children did not have severe dystonia or uncontrolled epileptic seizures; (8) children's parents gave their informed written consent.

This study was designed to be assessor-half blinded, randomized, and controlled. A physician who performed functional analysis were blinded to the undertaking of art therapy (or the lack thereof), but neither the patients nor the physiotherapist was blinded because it was impossible to conceal the implementation of art therapy from them.

After initial evaluation and randomization with the sealed tickets selection method, all patients were assigned either to

the control group (conventional rehabilitation program, n=5) or the art group (conventional rehabilitation program plus art therapy, n=5).

2. Intervention

All subjects participated in a conventional rehabilitation program for 1 day a week, 20 minutes a day, for 14 weeks. The conventional program is children-specific and is based on neurodevelopmental facilitation physiotherapy. Additionally, the art group also received art therapy for 1 day a week, 70 minutes a day, for 12 weeks, and orientation and performance for 2 weeks.

In this study, the art therapy program consisted of overall 14 sessions of 3 phases including the 1st phase of pre-treatment test and preparatory education (sessions 1-3: making name tags and introducing themselves), the 2nd phase of execution (sessions 4-10: activities such as playing with clay and making wish boxes that improve psychological and physical characteristics including fine and gross motor function, hand-eye coordination, and neuromuscular development), and the 3rd phase of assurance and post-treatment test (sessions 11-14: making sculptures of their hands and feet, launching their own balloons, making awards and gifts).

In order to promote interpersonal relationships, improve concentration and cooperation, and protect the children, the participation of caregiver was allowed during the art therapy sessions.

3. Outcome measure

All 9 assessment tests were performed 2 times: once during the baseline period (pre-treatment) and once at the end of the study (post-treatment).

1) Motricity Index (MI)

The MI test provides a rapid overall indication of extremities impairment. Muscle strength in each joint of the unilateral upper limb, lower limb and total limbs is tested by the Medical Research Council scale. Each score is 1 to 100 points and high scores represent good function of the limb (Collin & Wade, 1990). In this study, MI scores come from the average of two scores (one score from each side) for diplegia, and the hemiplegic side score for hemiplegia.

2) Trunk Control Test (TCT)

For CP patients, trunk control is an important feature for gait or ADL. The TCT is used to evaluate trunk mobility and balance. The scores range from 1 to 100 points and high scores represent good trunk movement. The TCT is examined by 3 points (0, 12, 25) on four simple trunk movements consisting of rolling to the weak side, rolling to the strong side, sitting up from lying down, and sitting in a balanced position on the edge of a bed for a minimum of 30 seconds (Franchignoni et al., 1997).

3) Gross Motor Function Measure (GMFM)

This test represents overall gross motor function in five dimensions which are A: lying and rolling, B: sitting, C: crawling and kneeling, D: standing E: walking, running, and jumping. GMFM was developed based on developmental processes of children. The total GMFM score (1 to 100) presents the average percentages (1 to 100) of each of the five dimensions. High scores represent good gross motor function (Russell et al., 1989).

4) Gross Motor Functional Classification System (GMFCS)

GMFCS, made by modifying GMFM, is composed of simple five stages of gross motor function. This test is a rapid evaluation tool for the overall disability degree of a child with developmental delays in gross motor function (Palisano et al., 1997) and presents the possibility of retrospective study and comparison of results according to each age group. The test has a high reliability and probability of prognostic prediction (Wood & Rosenbaum,

2000). Low scores represent more independent transfer or gait and less use of assistive devices.

5) Denver Developmental Screening Test-II (DDST-II)

DDST-II screens the overall developmental progress of children at or under age (Frankenburg et al., 1992). This test measures actual developmental age, and is composed of four skill dimensions: personal-social, fine motor-adaptive, language, and gross motor. In this study, the developmental delay ratio was calculated by subtracting measured age from the actual age and then dividing by the actual age.

6) Functional Independence Measure of Children (WeeFIM)

The WeeFIM instrument is one of the most commonly used methods for pediatric functional evaluation of children's ADL, which was developed from FIM for adults (Ottenbacher et al., 1997). The test consists of 6 subsets with a total of 18 measurements. The subsets are categorized as self-care, sphincter control, mobility, locomotion, communication, and social cognition. Each measurement of the subsets is scored on a scale of 1 (total assistance) to 7 (complete independence). The minimum total score is 18 (total dependence in all skills) and the maximum is 126 (complete independence in all skills). WeeFIM is reliable and valid in both children with disabilities and healthy children, making it an excellent method of evaluation (Ottenbacher et al., 1997).

7) Leg and Hand Ability Test (LHAT)

LHAT tests the motor function of the leg and hand (Dali et al., 2002). The test presents quantitative results of motor function of the upper (9 items) and lower (9 items) extremities. High scores represent better function of the leg except for one item (20 m walking). Low scores represent better function of the hand except for one item (pile of blocks). In this study, 20m walking for the leg or pile of blocks for the hand was analyzed separately from other items; the other 8 items for the hand and the leg were analyzed together. LHAT scores come from the summation of both side scores for diplegia, and hemiplegic side scores for hemiplegia.

4. Statistical analysis

We analyzed the data using SPSS for windows (Version 11.5 Standard). The group differences were compared using the Chi Square (χ^2) or the Mann-Whitney U test. The difference between pre-treatment data and post-treatment data in each group was compared using the Wilcoxon Signed ranks test. The improvement score between pre-treatment and post-treatment in each group was calculated by subtracting pre-treatment data from post-treatment data. The group improvement score difference between the art and the control groups was compared using the Mann-Whitney U test. An alpha level of .05 with two-tailed p values ($p<.05$) was set as significant difference.

Ⅲ. Results

1. General characteristics of the participants

All the children participated without dropping out throughout the whole process of the study. In both groups, the male to female ratio was 3 to 2 the diplegia to hemiplegia ratio was 4 to 1. The age range of the children was 44 to 94 months. The mean age was 67 months for the art group and 72 months for the control group. There was no significant difference between the two groups in age, sex, height, body weight, head circumference, morphological classification, or orthosis usage on gait ($p>.05$) (Table 1).

Table 1. Sociodemographic data of the participants

	Art group	Control group	*p*
No. of participants	5	5	NA
Age (months)	69.80±14.32	71.80±18.05	.675
Sex			1.000
Male	3 (60 %)	3 (60 %)	
Female	2 (40 %)	2 (40 %)	
Height (㎝)	109.40±2.70	112.40±9.45	.834
Body weight (㎏)	19.40±0.89	21.00±4.85	.829
Head circumference (㎝)	51.24±1.84	51.60±4.16	.530
Classification			1.000
Diplegia	4 (80 %)	4 (80 %)	
Hemiplegia	1 (20 %)	1 (20 %)	
Orthosis usage on gait	0 (0 %)	0 (0 %)	NA (constant)

Values are represented as mean±standard deviation or number (%), NA; Not applicable,
p values shown were derived from Chi Square or Mann-Whitney tests

2. Changes in motor function, motor quality and developmental state, and ADL

In the art group, upper extremity and total scores in the MI test, total score in GMFM, and self-care and total scores in WeeFIM were significantly different between pre-treatment and post-treatment ($p<.05$) (Table 2). Locomotion score in WeeFIM of the art group improved in borderline ranges ($p=.066$) (Table 2). In the control group, there was no significant difference between pre- and post-treatment ($p>.05$) (Table 2). However, the total score in WeeFIM of the control group improved in borderline ranges ($p=.066$) (Table 2). The improvement scores of upper extremity and total scores in the MI test were significantly different between the two groups ($p<.05$) (Table 2).

Table 2. Comparison of changes in motor function, motor quality and developmental state over 12 weeks in each group

	Art group				Control group				*p*
	Pre-	Post-	*p*	Change	Pre-	Post-	*p*	Change	(change)
Motricity index									
Upper extremity	72.7 ±9.08	81.3±14.5	.043*	8.7±10.1	78.6±13.3	78.6 ±13.3	1.000	0.0±.0	.012*
Lower extremity	76.1 ±10.0	80.7±10.4	.144	4.6±8.2	72.7±18.7	73.9 ±17.7	.180	1.2±2.4	.674
Total	74.8±7.7	81.9±11.7	.027*	7.1±7.7	76.0±15.4	76.6 ±15.0	.180	0.6±1.1	.033*
TCT	97.4±5.8	100.0±.0	.317	2.6±5.8	100.0±.0	100.0±.0	1.000	0.0±.0	.317
GMFM									
Lying-Rolling	100.0±.0	100.0±.0	1.000	0.8±.0	100.0±.0	100.0±.0	1.000	0.0±.0	1.000
Sitting	100.0±.0	100.0±.0	1.000	0.8±.0	100.0±.0	100.0±.0	1.000	0.0±.0	1.000
Crawling-Kneeling	100.0±.0	100.0±.0	1.000	0.8±.0	100.0±.0	100.0±.0	1.000	0.0±.0	1.000
Standing	92.4±2.5	93.8±1.6	.102	1.4±1.3	92.5±7.9	93.5±7.8	.317	1.0±2.2	.408
Walking-Running-Jumping	89.4±6.4	91.4±3.7	.109	2.0±2.8	85.2±13.0	85.6±14.7	.593	0.4±4.5	.448
Total	96.4±1.2	97.0±0.8	.043*	0.7±0.4	95.5±4.0	95.8±4.4	.465	0.3±1.0	.530
GMFCS	1.4±0.6	1.0±0.5	.317	0.2±0.5	1.2±.5	1.0±.5	1.000	0.0±.0	.317

Table 2. Comparison of changes in motor function, motor quality and developmental state over 12 weeks in each group(continue)

	Art group				Control group				*p* (change)
	Pre-	Post-	*p*	Change	Pre-	Post-	*p*	Change	
DDST-2									
Personaln-Social	52.8±13.0	54.4±9.5	.317	1.6±3.6	54.0±13.4	54.6±12.1	.317	0.6±1.3	.881
Fine motor	69.0±4.2	69.8±3.0	.317	0.8±1.8	6.0±20.8	62.4±15.7	.317	2.4±5.4	.881
Language	63.0±8.8	64.8±9.9	.083	1.8±1.6	56.4±19.4	58.6±19.0	.109	2.2±2.5	1.000
Gross motor	53.8±6.4	56.4±6.5	.102	2.6±3.1	53.4±18.1	54.2±17.3	.102	0.8±0.8	.584
WeeFIM									
Self care	26.2±7.5	32.8±4.2	.042*	6.6±4.7	29.8±4.4	33.0±8.0	.141	3.2±5.3	.344
Sphincter control	13.4±0.9	14.0±.0	.180	0.6±0.9	13.2±1.1	13.4±.9	.317	0.2±.5	.439
Mobility	19.0±1.9	20.6±0.9	.102	1.6±1.5	12.2±8.0	17.4±6.5	.180	5.2±7.2	.911
Locomotion	10.8±1.5	12.4±1.3	.066	1.6±1.5	11.4±1.1	12.6±2.0	.109	1.2±1.3	.667
Communication	9.6±3.9	10.6±5.0	.129	1.0±1.2	10.6±2.7	10.8±3.4	.655	0.2±1.1	.281
Social cognition	13.4±5.5	14.6±5.4	.357	1.2±2.6	12.8±4.7	12.0±4.4	.357	-0.8±1.9	.206
Total	92.4±18.9	105.0±12.4	.042*	12.6±8.6	90.0±17.2	99.2±20.9	.066	9.2±6.1	.599

*p<.05 by Wilcoxon signed ranks test or Mann-Whitney test, TCT; Trunk control test, GMFM; Gross Motor Function Measure, GMFCS; Gross Motor Function Classification System, DDST; Denver Developmental Screening Test, WeeFIM; Wee Functional Independence Measure

3. Changes in leg and hand function

In the art group, subtotal score in leg ability test, 20m walking score in leg ability test, and subtotal score in hand ability test showed significant difference between pre-treatment and post-treatment (p<.05) (Table 3). In the control group, 20m walking score in leg ability test and subtotal score in hand ability test showed significant difference between pre- and post-treatment (p<.05) (Table 3). The improvement score of the subtotal score in leg ability test was significantly different between the two groups (p<.05) (Table 3).

Table 3. Comparison of changes in leg and hand function over 12 weeks in each group

Test		Art group				Control group				*p* (change)
		Pre-	Post-	*p*	Change	Pre-	Post-	*p*	Change	
Leg ability test										
Subtotal		104.7±35.7	119.2±41.9	.008*	14.6±41.9	131.8±54.7	127.6±54.1	.159	-4.2±7.6	.001*
20MW	Step	45.8±4.6	52.8±7.0	.043*	-7.0±3.8	48.4±8.0	53.4±7.1	0.042*	-5.0±3.3	.401
	Sec	21.6±3.0	23.6±3.6	.144	-2.0±2.6	22.6±4.2	22.8±2.2	1.000	-2.0±4.4	.402
Hand ability test										
Subtotal		262.4±55.6	199.1±46.1	.008*	-63.3±23.8	280.7±177.8	176.9±48.7	0.015*	-103.8±135.9	.566
Pile of blocks		7.2±2.7	7.1±2.5	.498	0.1±2.5	8.6±2.2	9.0±1.8	0.336	-0.4±1.8	.138

*p<.05 by Wilcoxon signed ranks test or Mann-Whitney test, 20 MW: 20 m walking

Ⅳ. Discussion

The practice of utilizing art for healing purposes is as ancient as drawings on the walls of a cave, yet the profession of art therapy itself remains new in the family of mental health fields (Rubin, 2010). Art therapy, developed

from the theories of Sigmund Freud and Carl Jung, led to a new understanding of the human personality and ways of approaching the genesis of illness. Art therapy was first organized in the 1930s, where psychiatrists studied the artworks of patients to seek a link between the art and the illness of their patients. Since then, the profession of art therapy has grown into an effective and important method of communication, assessment, and treatment with many populations. Art therapy is an intervention providing adjunctive psychological support using creative activities for various psychiatric illnesses. The process of art therapy induces natural, intrinsic, imaginative, creative, and internal expression and can provide positive effects in patients with developmental, learning, social adaptive, and psychiatric disorders (Kazdin, 2000). Hans Prinzhorn, art historian and psychiatrist (Prinzhon, 1972), reported that artworks by 500 psychiatric patients could provide diagnostic information and contribute positively to their psychological rehabilitation (Kang et al., 2006). Furthermore, Lee et al. (2006) reported improvement of general adaptive behaviors such as gross and fine motor function by applying an art therapy program to children with severe CP. Thus the comprehensive art therapy in this study was designed to improve physical and motor functions, performing ADL, and motor capacity of upper and lower extremities using motion-oriented supportive art therapy. This study was conducted to observe the effects of this comprehensive art therapy (along with a conventional rehabilitation program) in the motor function (physical component) and the ADL (activity component) of children with CP.

In the physical and motor function evaluation, this study showed that in the art therapy group, gross motor function from GMFM and strengths of the upper limb and total unilateral limbs from MI were improved significantly after art therapy. Strengths of upper limb and total unilateral limbs from MI of the children in the art group were significantly more improved than those in the control group.

Therefore, art therapy helped in upper limb and overall strength recovery, restored more muscle strength compared to the control group, and improved general motor function. Upper-extremity training activities such as two-hand drawing, kneading clay, and scribbling are thought to have positively influenced upper limb strength and overall strength. The improvement in hand-eye coordination, ability to imitate, muscle movement, and concentration was reported in conducting developmental and social maturity tests in children with developmental disabilities who have received artistic and formative activities (Kim, 2001). In the present study, when the overall developmental level was evaluated using DDST-II, no significant change in developmental level was found in either groups in the four evaluation items of the test. This reflects the severity of the developmental delay in children with CP and is considered to be a limitation of the assessment method using the DDST-II developmental screening test. It is thought that developmental improvement of a child with CP and general developmental delay could not be observed in such a short period of time. Furthmore, the DDST-II test, which is used as a developmental screening test, did not reflect small changes in the overall developmental level, because all participants had slight motor impairment, had level I or II in GMFCS in this study.

The purpose of art therapy is to experience pleasure in the early stages, to achieve psychological stability in the middle stage, and to overcome the problems of daily life in the stage of differentiation (Malchioldi & Coolidge, 2000). In the present study, when the children of ADL were evaluated using the WeeFIM, the art therapy group showed significant improvement in self-care and total score safter the treatment. Additionally, the art therapy group showed improvement in the statistical borderline ranges in the locomotion score of the WeeFIM. In the control group, improvement in the statistical borderline ranges was observed in the total score of the WeeFIM. There was no significant difference between the two groups before the treatment and after. Therefore, comprehensive art therapy showed a tendency to have effects in self-care activities, general daily activities, and locomotion movements. As a

result, it was found that art therapy can induce positive changes in self-care activities using the upper limb and locomotion movements using the lower limb.

These results might come from training using various materials such as papers, clay, foil, and natural materials (through fine motor improvement of the upper limb and hand) and various whole body exercises such as group activities, balloon blowing, balloon flying by a fan, and modeling one's hands and feet (through gross motor improvement of large limb muscle).

In art therapy, activities that involve manipulating or rotating with both hands and feet, which are kneading clay, holding heavy objects, and handling objects of various sizes, lead to improvement of coordination, endurance and strength (Kang et al., 2006; Wilton, 2003). In this study, the art therapy group showed a significant improvement in the total score of (LHAT) lower extremity motor abilities and the total score of (LHAT) upper extremity motor abilities after treatment compared to before treatment. In the control group, after the treatment, (LHAH) motor abilities of the lower extremities in the 20m walking steps and the total score of (LHAT) upper extremity motor abilities showed a significant improvement after treatment compared to before treatment. There was a significant difference between the two groups in the total scores of (LHAT) lower extremity motor abilities when comparing the improvement scores. Therefore, art therapy induces a significant improvement in lower limb function, and it also has a tendency to induce improvement in the upper limb function, although it was not superior to the effect induced by the physical therapy. These results suggest that art therapy may be effective in increasing lower extremity function more than upper limb function through unequal dominant neural plasticity and neural recovery abilities which are inducing the development of gross and fine motor development, improvement of physical ability, improvement of throwing ability or physical balance, and improving hand functionor walking ability in cerebral disease (Braddom, 1998).

In this study, a comprehensive range of improvement was observed in upper extremity muscle strength, and physical function performance of leg function in children with CP undergoing physical rehabilitation therapy. Therefore, comprehensive art therapy can be used as an adjunctive therapy in the treatment of children with CP in the future.

However, in this study, there were several limitations. Enrolled children was small number, had mild motor impairment, and the art activities were performed for a relatively short period of 12 weeks. It also was impossible to control influences and relationships with guardians when they participated in the art therapy. Finally, it was difficult to quantify the nature of this art therapy and to compare it with other art therapies. As a part of a comprehensive rehabilitation therapy that will resolve these problems in the future, a large-scale, controlled study on art therapy should be conducted.

Thus, this study revealed that comprehensive art therapy in addition to physiotherapy was limitedly effective in the upper extremity strength and leg ability in children with CP. This suggests that comprehensive art therapy could be utilized as an effective adjunctive therapy to physical therapy for children with CP.

Ⅴ. Conclusion

The purpose of this study was to investigate the effects of comprehensive art therapy on physical function and ADL in children with CP. In the art therapy group, muscle strength of upper limb and limb of whole body, WeeFIM's self-care and total scores, and LHAT leg and arm function were a significant improvement after treatment compared to before. In the art therapy group, the strength of the upper extremity and the limb as a whole, and the leg function improved significantly compared to the control group.

In this study, after the comprehensive art therapy, range of improvement was observed in the upper extremity

muscle strength and leg function in children with CP undergoing physical rehabilitation therapy. Therefore, in the future, comprehensive art therapy can be used as an adjunctive treatment to rehabilitation in the treatment of children with CP.

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