ORIGINAL ARTICLE

IJPHY

IMPACT OF COMBINING MIRROR THERAPY AND HABIT ON HAND GRIP STRENGTH IN CHILDREN WITH HEMIPARESIS

[1]Asmaa A. Abo Nour (PHD)
[2]Muhammad G. Saleh (MSC)
[3]Emam H. Elnagmy

ABSTRACT

Background: hemiparetic children usually tend to avoid the use of their impaired arm and are remarkably tend to perform inherently bimanual tasks of daily living with the less impaired arm only rather than with both arms .In fact, these children actually may have never learned to use their impaired arm for certain motor tasks or may only use it in the simplest manner, so the purpose of the study was to determine the impact of combining HABIT and mirror therapy on hand grip in hemiparetic children.

Methods: A total of 30 hemiparetic children divided randomly into two groups (A and B) of equal number, (N of each =15). Eligibility criteria to our study were age ranged from 4-8 years, ability to score more than 50 % of grasps and associated domains of quality of upper extremity skills test (QUEST) and grade 2 in manual ability classification system (MACS), assessment done by baseline hand held dynamometer for hand palmar & pinch grasp strength (in pounds) at start (0 week), reassessed at 4 & 8 weeks. The treatment protocol for two groups include: 2 months total time, 3 sessions\ week, 1.5 hour\session. Children in study group (A) received selected occupational therapy program with modified mirror apparatus while children in control group (B) Children received the same occupational therapy program as in study group but without modified mirror apparatus.

Results: there is significant improvement in both groups when comparing the pre and post I & II treatment mean values. However comparing the post treatment results of both groups were statistically non-significant.

Conclusion: This study confirmed that combining mirror therapy and HABIT is effective in improving hand function.

Keywords: Hemiparesis, QUEST, MACs, Palmar grasp, Pinch grasp, HABIT, Mirror therapy.

Received 26th May 2016, revised 13th June 2016, accepted 17th July 2016

www.ijphy.org

10.15621/ijphy/2016/v3i4/111055

[2]Pediatric Department in Agouaza Military Rehabilitation Center-Ministry of Defence-Cairo, Egypt.
[3]Department of Physical Therapy for Growth and Developmental Disorders in Children and its Surgery, Faculty of Physical Therapy, Cairo University, Cairo, Egypt.

CORRESPONDING AUTHOR

[1]Asmaa A. Abo Nour (PHD)

Department of Physical Therapy for Growth and Developmental Disorders in Children and its Surgery, Faculty of Physical Therapy, Cairo University, Cairo, Egypt.

INTRODUCTION

The resulting movement impairments are largely localized to one side, with the upper extremity usually being affected more than the lower extremity in children with hemiplegic cerebral palsy [1,2]. Abnormal muscle tone with posturing into wrist flexion, ulnar deviation, elbow flexion, and shoulder internal or external rotation in addition to reduced strength, as well as tactile and proprioceptive disturbances are the resulting impairments to upper extremities. All the previous impairments can result in abnormal development of hand skills and consequently affect functional independence and quality of life as well as skilled independent finger movement [3,4]. Impaired hand control is a major disability in children with hemiplegic cerebral palsy, so hemiplegic children often prefer to not use the involved upper extremity and learn to perform most tasks exclusively with their less affected upper extremity [5].

Brain damage associated with hemiplegia often includes areas known to be involved in bimanual coordination such as the supplementary motor area and the parietal lobe [5,6]. During symmetrical bimanual movements there is a coupling of movements of the two limbs with one or both of the movements being affected [6–8]. Hand Arm Bimanual Intensive Training (HABIT) created to address the use of bilateral arm movements with numerous activities of daily living (A. D. Ls) and hypothesized to be more useful training than uni-lateral training, through enabling facilitation of the damaged hemisphere via interhemispheric connections [9].

Mirror therapy has been excessively used and searched as a method to treat the upper extremities of hemiplegic patients. Mirror therapy involves performing movements of the less affected limb while watching its mirror reflection superimposed over the (hidden) affected limb, thus creating a visual illusion of enhanced movement capability in the affected limb [10]. This is a therapeutic intervention that uses visual feedbacks for neuroplasticity and triggers motivation through visual feedbacks during training [11,12]. Voluntary movement of the affected upper extremity and hand using a mirror stimulate the bilateral cortex and causes rearrangement in other areas around the lesioned part of the brain, thus allowing for replacement of its function and thereby influence motor function recovery [13]. Mirror visual feedback was expected to enhance reorganization and stimulate plasticity of the premotor cortex Through modified vision and perception [14]. Mirror therapy involves repetitive bimanual, symmetrical movement practice in which the patient moves the affected limb as much as she/he could while watching the reflective illusion of the unaffected limb from a mirror [15].

Therefore, the purpose of this study was to detect the impact of combining HABIT and mirror therapy on hand function in hemiparetic children.

MATERIALS AND METHODS

Patients:

Thirty hemiparetic children (19 boys and 11 girls) were recruited from out-patient clinic, Faculty of Physical therapy and Pediatric Department in Agouaza Military Rehabilitation Center-Ministry of Defence-cairo, children were selected according the following criteria:

a) age ranged from 4-8 years old, b) mild to moderate spasticity (grade one to two according to Tardieu scale), c) level two of bilateral hand use according to MACs scale, d) able to follow simple verbal commands or instructions included in the evaluation and treatment procedures, children were exculded if they have:

a) Visual impairments, b) acute pain in either of upper limbs, c) fixed deformities of the upper limbs, d) Botulinium-toxin injections (BT-A) in the past 6 months pre measurements, e) surgical intervention in the upper extremities.

The following data were collected: age, sex, height, weight, strength of palmar and pinch grasps of both affected and non affected.

Sampling methods: convenient sample of spastic hemiplegic children were classified in two groups of equal numbers.

Ethical consideration:

All children's partents provided written consent before starting in the study; the local ethics committee approved from ethical committee of Faculty of Physical Therapy, Cairo University

- The children were randomly allocated in two groups of 15: Study group (A), received an occupational therapy program with modified mirror apparatus while Control group (B), received the same occupational therapy program but without modified mirror apparatus.

Duration of the Study: In group A, each child was received the selected occupational therapy program for 1.5 hours per session with modified mirror apparatus, 3 sessions per week plus 1 hour of daily training at home with mirror and bilateral hand training for total of 8 weeks while in group B, each child received the same occupational therapy program for 1.5hours per session at 3 sessions per week, beside home program for 1 hour daily for 8 weeks.

Instrumentation: For selection and evaluation: a- For children selection:

- Quality of Upper Extremity Skills Test (QUEST):

Used for selection of children eligible for study, this test consists of 7 domains, however for this study only part A (Dissociated movements) & part B (Grasps) was conducted. QUEST was validated for children between 18 months and 8 years of age, total of items of part A&B equal 64 with max scoring 128 point so average of 64 points were eligible level for children in this study [16].

- **Manual Ability Classification system (MACS):**
MACS describe how children used their hands during object handling and their need for assistance to perform manual skills in everyday life [17].
The severity of performance limitation and degree of required assistance increases for each MACS level from 1 to 5. The eligible children score was 2 in MACS for selection in this study.

b- For evaluation

- **Basline Hand Held Dynamometer:**
Used for assessment and re-assessment of hand function (palmar and pinch grasp in pounds). The smallest bulb will be used for testing pinching and gripping function of intrinsic hand muscles. Scale is calibrated in an international unit of energy (bar).
Both affected and non affected hand assessed by Baseline Pneumatic Bulb Hand Dynamometer.

- The affected hand grip and pinch assessed and re-assessed at 0-4-8 weeks post intervention by baseline pneumatic bulb hand dynamometer [18].
    - The patients performed the test while sitting comfortably with shoulder adducted and neutrally rotated forearm, elbow flexed to 90 degrees, and forearm and wrist in neutral position. The patients were instructed to perform a maximal isometric contraction. The test was repeated within 30 seconds and the mean value of three tests was used for the analysis.

For treatment:

1 - Modified mirror apparatus is wooden box consists of combination of 2 slidded mirrors 50 cm length and 50 width each one with a glass screen in-between.

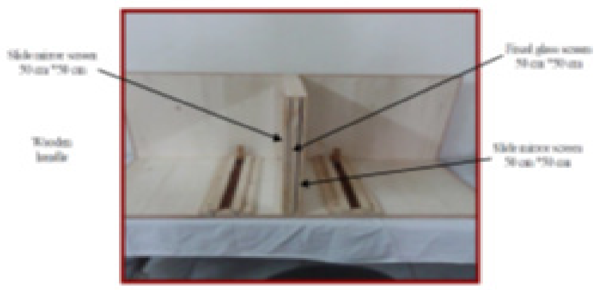

Figure 1: Modified mirror apparatus with slide screens

2 - Occupational therapy equipments like small balls, pens, cubes and pins.

Figure2: Modified mirror apparatus with occupational therapy equipments

PROCEDURES: For Treatment: Study Group (A):

Children received an occupational therapy program with modified mirror apparatus consisted of:

- Squeezing a ball by less affected hand in front of mirror while child look at hand reflection (uni-manual),Squeezing 2 balls with both hands with glass screen in between, Moving 2 wooden handles with both hands with glass screen in-between (bi-manual movement),Moving a handle by less affected hand in front of mirror while child look at hand reflection, making a circular movement with less-affected hand with mirror and making a circular movement with both hands (bi-manual) with glass screen in-between.

Figure 3: Visual feedback by glass screen

Figure 4: Making circular movement with less affected hand in front of mirror.

Control Group (B):

Children received the same occupational therapy program as in study group but without modified mirror apparatus:

Squeezing a ball by affected hand, Squeezing 2 balls by 2 hands, Making circular movements by affected hand, Making circular movements by both hands together at the same time, moving a cube by affected hand foreword and moving 2 cubes by both hands foreword.

DATA STATISTICAL ANALYSIS:

- Descriptive statistics and t-test for comparison of the mean age, weight, and height between both groups.
- T-test for comparison of pinch grasp, palmar grasp between both groups.
- ANOVA with repeated measures for comparison between pre, post I, and post II treatment mean values of pinch grasp, palmar grasp. The level of significance for all statistical tests was set at $p < 0.05$.
- All statistical measures were performed through the statistical package for social studies (SPSS) version 19 for windows.

RESULTS

- Subject characteristics:

Table 1, showed the mean ± SD age, weight and height of study and control groups. There was no significant difference between both groups in the mean of all variables.

Table 1: Age, weight and height of both study and control groups

	Study group		Control group		
	Mean	Std. Deviation	Mean	Std. Deviation	*p value
Age (years)	5.8273	0.92356	5.7513	1.04273	0.433
WT (KG)	25.533	5.0493	23.125	4.5493	0.969
height (cm)	113.444	10.2727	107.125	12.5293	0.279

*p value is significant ≤0.05

a- Comparison between groups pre treatment

- Pre treatment mean values of pinch & palmar grasp of both groups (study and control):

The mean ± SD pinch grasp of the affected side pre treatment of study group was 0.86 ± 0.51 lb and that of control group was 0.66 ± 0.32 lb. The mean difference between both groups was 0.2 lb. There was no significant difference between both groups in pinch grasp of the affected side pre treatment (p = 0.25).

The mean ± SD palmar grasp of the affected side pre treatment of study group was 2 ± 0.82 lb and that of control group was 1.54 ± 0.72 lb. The mean difference between both groups was 0.46 lb. There was no significant difference between both groups in palmar grasp of the affected side pre treatment (p = 0.14).

Table 2: Comparison between pre treatment mean values of pinch grasp of both groups (study and control).

Affected side	Study group	Control group	MD	t-value	p-value	Sig
	$\bar{X}$ ±SD	$\bar{X}$ ±SD				
Pinch grasp (lb)	0.86 ± 0.51	0.66 ± 0.32	0.2	1.16	0.25	NS
Palmar grasp (lb)	2 ± 0.82	1.54 ± 0.72	0.46	1.51	0.14	NS

$\bar{X}$: Mean SD: Standard Deviation
MD: Mean difference t value: Unpaired t value
p value: Probability value NS: Non significant

b- Results of study group:

- Pre treatment, post I, and post II mean values of pinch grasp of the affected side:

The mean ± SD pinch grasp of the affected side of study group pre treatment was 0.86 ± 0.51 Ib, while at post I was 1.5 ± 0.77 Ib and at post II was 2.2 ± 1.14 Ib. Comparison between pre treatment, post I, and post II measurements revealed a significant difference in pinch grasp of the affected side between the three time intervals (p = 0.0001).

Table3: Comparison between pre treatment, post I and post II mean values of pinch grasp of the affected side of study group:

Pinch grasp of the affected side (lb)			F- value	p-value	Sig.
$\bar{X}$ ±SD					
Pre treatment	Post I	Post II			
0.86 ± 0.51	1.5 ± 0.77	2.2 ± 1.14	36.23	0.0001	S
Multiple comparison (Bonferroni test)					
	MD	% of improvement	p- value	Sig	
Pre- post I	-0.64	74.41	0.0001	S	
Pre- post II	-1.34	155.81	0.0001	S	
Post I- post II	-0.7	46.66	0.0001	S	

$\bar{X}$: Mean, MD: Mean difference, S: Significant, SD: Standard deviation, p value: Probability value

- Pre treatment, post I, and post II mean values of palmar grasp of the affected side :

The mean ± SD palmar grasp of the affected side of study group pre treatment was 2 ± 0.82 Ib, while at post I was 2.56 ± 1.01 Ib and at post II was 3.13 ± 1.02 Ib. Comparison between pre treatment, post I, and post II measurements revealed a significant difference in palmar grasp of the affected side between the three time intervals (p = 0.0001).

Table 4: Comparison between pre treatment, post I and post II mean values of palmar grasp of the affected side of study group:

Palmar grasp of the affected side (lb)			F-value	p-value	Sig.
$\bar{X}$ ±SD					
Pre treatment	Post I	Post II			
2 ± 0.82	2.56 ± 1.01	3.13 ± 1.02	47.04	0.0001	S
Multiple comparison (Bonferroni test)					
	MD	% of improvement	p-value	Sig.	
Pre- post I	-0.56	28	0.0001	S	
Pre- post II	-1.13	56.5	0.0001	S	
Post I- post II	-0.57	22.26	0.001	S	

$\bar{X}$: Mean, MD: Mean difference, S: Significant, SD: Standard deviation, p value: Probability value

c- results of control group:

- Pre treatment, post I, and post II mean values of pinch grasp of the affected side:

The mean ± SD pinch grasp of the affected side of control group pre treatment was 0.66 ± 0.32 Ib, while at post I was 1.12 ± 0.52 Ib and at post II was 1.7 ± 0.72 Ib. Comparison between pre treatment, post I, and post II measurements revealed a significant difference in pinch grasp of the affected side between the three time intervals (p = 0.0001).

Table 5: Comparison between pre treatment, post I and post II mean values of pinch grasp of the affected side of control group:

Pinch grasp of the affected side (lb)			F-value	p- value	Sig.
$\bar{x}$ ±SD					
Pre treatment	Post I	Post II			
0.66 ± 0.32	1.12 ± 0.52	1.7 ± 0.72	29.27	0.0001	S
Multiple comparison (Bonferroni test)					
	MD	% of improvement	p-value	Sig.	
Pre- post I	-0.46	69.69	0.002	S	
Pre- post II	-1.04	157.57	0.0001	S	
Post I- post II	-0.58	51.78	0.007	S	

$\bar{x}$: Mean, MD: Mean difference, S: Significant, SD: Standard deviation, p value: Probability value

- Pre treatment, post I, and post II mean values of palmar grasp of the affected side:

The mean ± SD palmar grasp of the affected side of control group pre treatment was 1.54±0.72 Ib, while at post I was 2.25 ± 0.96 Ib and at post II was 2.83±0.74 Ib. Comparison between pre treatment, post I, and post II measurements revealed a significant difference in palmar grasp of the affected side between the three time intervals (p = 0.0001).

Table 6: Comparison between pre treatment, post I and post II mean values of palmar grasp of the affected side of control group:

Palmar grasp of the affected side (lb)			F- value	p-value	Sig
$\bar{x}$ ±SD					
Pre treatment	Post I	Post II			
1.54 ± 0.72	2.25 ± 0.96	2.83 ± 0.74	25.73	0.0001	S
Multiple comparison (Bonferroni test)					
	MD	% of improvement	p- value	Sig	
Pre- post I	-0.71	46.1	0.004	S	
Pre- post II	-1.29	83.76	0.0001	S	
Post I- post II	-0.58	25.77	0.02	S	

$\bar{x}$: Mean, MD: Mean difference, S: Significant, SD: Standard deviation, p value: Probability value

D- Comparison between groups post treatment

- Post treatment mean values of pinch grasp of the affected side of both groups (study and control):

The mean ± SD pinch grasp of the affected side of study group at post I was 1.5 ± 0.77 Ib and that of control group was 1.12 ± 0.52 Ib. The mean difference between both groups was 0.38 Ib. There was no significant difference in the mean values of pinch grasp of the affected side between both groups at post I (p = 0.16).

The mean ± SD pinch grasp of the affected side of study group at post II was 2.2 ± 1.14 Ib and that of control group was 1.7 ± 0.72 Ib. The mean difference between both groups was 0.5 Ib. There was no significant difference in the mean values of pinch grasp of the affected side between both groups at post II (p = 0.2).

Table 7: Comparison between post treatment mean values of pinch grasp of the affected side of both groups (study and control).

Pinch grasp of the affected side (lb)	Study group	Control group	MD	t-value	p-value	Sig
	$\bar{x}$ ±SD	$\bar{x}$ ±SD				
Post I	1.5 ± 0.77	1.12 ± 0.52	0.38	1.42	0.16	NS
Post II	2.2 ± 1.14	1.7 ± 0.72	0.5	1.29	0.2	NS

$\bar{x}$: Mean, SD: Standard Deviation, MD: Mean difference

t value: Unpaired t value, p value: Probability value, NS: Non significant

Time of Evaluation

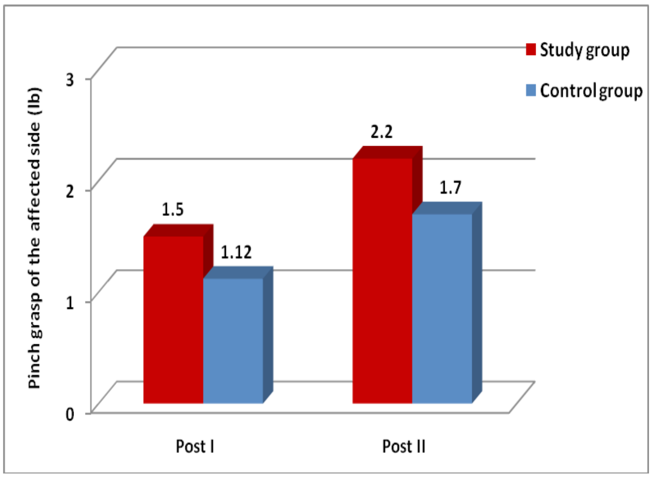

Figure 7: Post treatment mean values of pinch grasp of the affected side of study and control groups.

- Post treatment mean values of palmar grasp of the affected side of both groups (study and control):

The mean ± SD palmar grasp of the affected side of study group at post I was 2.56 ± 1.01 Ib and that of control group was 2.25 ± 0.96 Ib. The mean difference between both groups was 0.31 Ib. There was no significant difference in the mean values of palmar grasp of the affected side between both groups at post I (p = 0.41).

The mean ± SD palmar grasp of the affected side of study group at post II was 3.13 ± 1.02 Ib and that of control group was 2.83 ± 0.74 Ib. The mean difference between both groups was 0.3 Ib. There was no significant difference in the mean values of palmar grasp of the affected side between both groups at post II (p = 0.4).

Table 8: Comparison between post treatment mean values of palmar grasp of the affected side of both groups (study and control).

Palmar grasp of the affected side (lb)	Study group	Control group	MD	t-value	p-value	Sig
	$\bar{X}$ ±SD	$\bar{X}$ ±SD				
Post I	2.56 ± 1.01	2.25 ± 0.96	0.31	0.82	0.41	NS
Post II	3.13 ± 1.02	2.83 ± 0.74	0.3	0.84	0.4	NS

$\bar{X}$: Mean, SD: Standard Deviation, MD: Mean difference

t value: Unpaired t value, p value: Probability value, NS: Non significant

Time of Evaluation

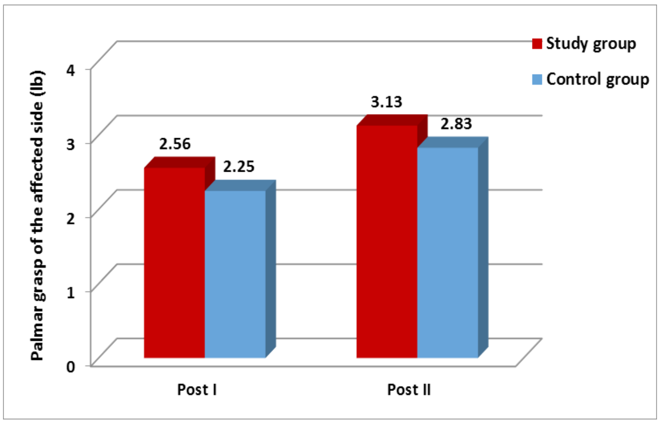

Figure 8: Post treatment mean values of palmar grasp of the affected side of study and control groups.

DISCUSSION

The purpose of this study was to evaluate the effect of combining HABIT and mirror therapy on hand grip strength in hemiparetic children. Thirty hemiparetic children (19 boys and 11 girls) were recruited from out-patient clinic, Faculty of Physical therapy and Pediatric Department in Agouaza Military Rehabilitation Center Ministry of Defence Cairo. Children were divided randomly into two groups of equal numbers, control group which received selected occupational therapy program with concentration on bilateral hand use exercises in addition to home training program and study group which received the same treatment program while using modified mirror apparatus for two successive months. Choosing hand control problem in hemiparetic cerebral palsy to be studied rather than any other problems as Bax et al. [19] reported that hemiparetic cerebral palsy children which occurred due to brain damage during early development, these children have motor disorders (i.e. loss of motor function) on one side of the body (i.e. one arm and one leg), As a result of this unilateral impairment these children experience problems with the daily movements performance, predominantly of movements that require the involvement of both upper limbs, which severely hampers their capacities and functional independence and supported by Smorenburg et al. [20] who stated that children with hemiplegia represents for 30% of all CP cases and results in motor impairments that are affected one side of the body (the impaired side of the body, contra lateral to the lesion hemisphere). In general, the upper extremity is more severely affected than the lower extremity; it is therefore not surprising that the manual abilities of the involved body side in spastic hemiparetic CP have been studied extensively.

The results of this study revealed that in the control group, pinch grasp and palmar grasp of affected hand revealed significant difference between pretreatment value, post I (4 weeks reassessment) and post II (8 weeks reassessment) which may be attributed to hand arm bimanual intensive therapy as this type of intervention differs from traditional physical and occupational therapy in at least two ways: (1) the intensity of training is far greater, providing sufficient opportunity for practice using principles of motor learning; (2) encouraging the use of the affected hand in any manner as the child was asked to use it as hormal children child use their non dominant hand, and especially to concentrate on how the hand and arm are performing at the end-point of the movement [21]. Hand arm bimanual intensive therapy which allowed children of the control group to simultaneously receive proprioceptive and visual feedback from the less affected limb (as in rolling dough against the table) that they do not receive during unilateral practice in which only the affected limb is used in the control group. This explanation is supported by Stephen et al. [22] who reported that when bilateral performance, a patient can use the unaffected extremities that have neurologically intact afferent and efferent signals as when looking and feeling movement within the non-involved limb, this will help him to execute similar movement by the involved limb. The current study depends on using both upper limbs simultaneously to activate the use of the affected upper limb which is supported by the study of Hussien et al. [23] who recorded improvement in shoulder and elbow joint angular displacement after using arm cycling due to improved coordinated movements between the two sides, as arm cycle provided improvement in bimanual motor performance.

Post-treatment improvement of pinch and palmar grasp of control group of both affected arm may also be explained as hand-arm bimanual intensive therapy which simultaneously facilitates the same neural networks in both hemisphere which reduces the inter hemispheric inhibition. This is because right and left hemispheres have symmetrical organization for hand control in the motor cortexes which are both facilitated during bimanual hand training that in turn leads to improvement in inter hemispheric communication and ipsilateral motor cortex activation of the affected hemisphere [24,25]. Also Mudie and Matyas [26] reported that, bilateral simultaneous movement encourage inter-hemispheric dis-inhibition which is likely to allow reorganization by sharing of normal movement commands from the undamaged hemisphere. Dis-inhibition may also promote recruitment of undamaged neurons to construct new task-relevant neural networks.

A lot of new therapeutic interventions have been extensively researched but in this study focus on mirror therapy as Hoare et al. [27] stated that New trends in non-surgical management in upper limb of hemiparetic cerebral palsy involved mirror therapy, constraint induced movement therapy (CIMT), modified constraint induced movement therapy (MCIMT) and botilinum toxin combined with traditional occupational therapy ,Improvements in palmar and pinch grasp strength after intervention in the mirror group were compared with those in the control group similar to results by Gygax et al. [18] who reported that Maximal grasp and pinch strength in children with hemiplegia increased significantly during the first half of training, followed by a plateau during the second half when compared effect of mirror therapy on maximal grasp strength and maximal pinch strength with traditional occupational therapy.

The improvement in grasp strength can be interpreted by Yavuzer et al. [28] who indicating that visual illusions that make patients feel as if they move two hands symmetrically which simultaneously activate both cerebral hemispheres and increase the excitability of the affected limb. The bilateral upper-limb training in mirror therapy using visual feedback improved paretic upper-extremity function, which, in turn, enhanced the palmar and pinch grasp strength. This consistent with Fukumura et al. [29] who suggested that the visual illusion of mirror therapy may enhance activity in the primary motor cortex, thereby increasing the descending neural drive from the brain to the muscles. This is congruent with the three studies using transcranial magnetic stimulation that identified an improvement of primary motor cortex excitability in healthy participants observing their movements in a mirror. Bimanual training improved hand strength significantly with trends towards a stronger effect of mirror training on grasp and of bilateral training on pinch.

In this study a modified mirror apparatus which combine both mirror therapy through right and left slidded mirror with a glass screen in between, the modified mirror apparatus allow to make easy combining of mirror therapy and hand arm bilateral hand therapy (HABIT) , beside it was joyful for the children due to enlarged size of the mirror. This can be interpreted by Mancini et al. [30] who reported that the enlarging mirror does not seem to affect RT to left hand recognition, but affect the body image which support that, mirror illusion occurred because it influenced the body image of the participants. This explanation is supported by Moseley et al. [31] who suggested that the painful limb is often felt enlarged in chronic pain therefore the minifying mirror might help establish a corrected body image. It is possible that the enlarging mirror only influence the body image. In chronic pain, a minifying mirror is thought to modulate the pain by changing the perceived size of the painful limb to be smaller, which also leads to the pain being perceived less.

In this study, both mirror therapy combined with HABIT and conventional therapy were applied to hemiparetic children, and the effect on palmar and pinch grasp independent measures was investigated. Both groups showed inter-group improvement, and the study group showed greater improvement in a comparison between the two groups but statistically non significant this supported by Kantak et al. [32] who reported that mirror therapy activated premotor area, which is the core area of motor control and plays a key role in motor recovery after brain damage, thereby increasing the activity of the partially damaged primary motor area and enhancing residual upper limb motor function. Furthermore, visualization of voluntary movement of the affected upper limb through a mirror can activate the complementary motion area in the bilateral inferior parietal lobe and the primary motion cortex, and this influences the recovery of motor function through reorganization, in which the functions of the damaged part of the brain are substituted by surrounding areas. A study done by Fukumura et al. [29] who stated that viewing the illusion of a functional paretic upper limb in a mirror seemed to have an immediate effect on motor unit recruitment, since maximal grasp strength tests performed behind the mirror were highly significantly stronger than those performed with the paretic limb under direct visual control, this coincided with the study done by Garry et al. [33] studied the effect of perceptual information on the excitability of the motor cortex. When vision of the inactive arm was obscured and replaced by a mirror reflection of the active ipsilateral arm, the excitability of primary motor area of the inactive contralateral arm was increased beyond that produced by ipsilateral arm movement alone. This effect may be particularly interesting for patients with unilateral brain damage, such as children with SHCP.

CONCLUSION

In conclusion, the two groups showed intergroup differences in both palmar and pinch grip of the affected limb after four weeks of therapy and more improvement after eight weeks, and the mirror therapy group showed greater improvement. This result indicates that mirror therapy combined with HABIT has positive effects on the improvement of hand function in children with hemiparesis.

REFERENCES

[1] Schieber MH, Santello M. Hand function: peripheral and central constraints on performance. J Appl Physiol (1985). 2004 Jun;96(6):2293-300.

[2] Duque J, Thonnard JL, Vandermeeren Y, Sebire G, Cosnard G, Olivier E. Correlation between impaired dexterity and corticospinal tract dysgenesis in congenital hemiplegia. Brain. 2003 Mar;126(Pt 3):732-47.

[3] Brown JK, Rensburg van E, Walsh G, Lakie M, Wright GW. A neurological study of hand function of hemiplegic children. Dev Med Child Neurol. 1987;29(3):287–304.

[4] Himmelmann K, Beckung E, Hagberg G, Uvebrant P. Gross and fine motor function and accompanying

impairments in cerebral palsy. Dev Med Child Neurol. 2006;48(6):417–23.
[5] Duff S, Gordon A. Learning of grasp control in children with hemiplegic cerebral palsy. Dev Med Child Neurol. 2003; 45(11):746– 757.
[6] Steenbergen B, Hulstijn W, Lemmens IH, Meulenbroek RG. The timing of prehensile movements in subjects with cerebral palsy. Dev Med Child Neurol 1998;40(2):108–14.
[7] Utley A, Steenbergen B. Discrete bimanual co-ordination in children and young adolescents with hemiparetic cerebral palsy: recent findings, implications and future research directions. Pediatr Rehabil. 2006;9(2):127–36.
[8] Utley A, Steenbergen B, Sugden DA. The influence of object size on discrete bimanual co-ordination in children with hemiplegic cerebral palsy. Disabil Rehabil. 2004;26(10):603–13.
[9] Latimer C, Keeling J, Lin B etal. The Impact of Bilateral Therapy on Upper Limb Function after Chronic Stroke: A Systematic Review. Dis abil Rehabil 2010; 32(15):1221-31.
[10] Stevens JA, Stoykov ME. Using motor imagery in the rehabilitation of hemiparesis. Arch Phys Med Rehabil. 2003, 84(7); 1090–1092.
[11] Jack D, Boian R, Merians AS, et al. Virtual reality-enhanced stroke rehabilitation. IEEE Trans Neural Syst Rehabil Eng. 2001; 9(3): 308–318.
[12] Ji SG, Cha HG, Kim MK et al. The effect of mirror therapy integrating functional electrical stimulation on the gait of stroke patients. J Phys Ther Sci. 2014;26(4): 497–499.
[13] Thirumala P, Hier DB, Patel P. Motor recovery after stroke: lessons from functional brain imaging. Neurol Res. 2002; 24(5): 453–458.
[14] Altschuler E, Wisdom S, Stone L. Rehabilitation of hemiparesis after stroke with a mirror. Lancet. 1999; 353(9169):2035-6.
[15] Michielsen M, Selles R, van der Geest J et al. Motor recovery and cortical reorganization after mirror therapy in chronic stroke patients: a phase II randomized controlled trial. Neurorehabil Neural Repair. 2011 ;25(3):223-33.
[16] DeMatteo C, Law M, Russell D, Pollock N et al. Quality of Upper Extremity -Skills Test. Hamilton, Ontario: Neuro developmental Clinical Research Unit, Chedoke-McMaster Hospitals ,1992.
[17] Eliasson A, Krumlinde L, Rosblad B et al. The Manual Ability Classification System (MACS) for children with cerebral palsy: scale development and evidence of validity and reliability. Dev Med Child Neurol. 2006;48(7):549 –554.
[18] Gygax M, Schneider P, Newman C. Mirror therapy in children with hemiplegia: a pilot study. Dev Med Child Neurol. 2011;53(5): 473-476.
[19] Bax M, Goldstein M, Rosenbaum P. Executive Committee for the Definition of Cerebral Palsy: Proposed definition and classification of cerebral palsy. Dev Med Child Neurol. 2005; 47(8): 571-576.
[20] Smorenburg A, Ledebt A, Deconinck F et al. Visual feedback of the non-moving limb improves active joint-position sense of the impaired limb in Spastic Hemiparetic Cerebral Palsy. Res Dev Disabil. 2011; 32(3): 1107-1116.
[21] Gormley ME. Treatment of neuromuscular and musculoskeletal problems in cerebral palsy. Pediat Rehabil. 2001;4(1):5–16.
[22] Stephen J, Page, Levine P. Biomechanics archives: bilateral training aids rehabilitation progression. Dev Med Child Neurol. 2005;44:25–33.
[23] Hussien ZA, El Shennawy SA, Abd Elwahab MS. Effect of arm cycling on gait of children with hemiplegic cerebral palsy. Egyptian J Med Hum Genet. 2014;15(3):273–9.
[24] Cauraugh JH, Lodha N, Naik SK, Summers JJ. Bilateral movement training and stroke motor recovery progress: a structured review and meta-analysis. Hum Mov Sci 2010;29(5):853–70.
[25] Donchin O, Gribova A, Steinberg O, Mitz AR, Bergman H, Vaadia E. Single-unit activity related to bimanual arm movements in the primary and supplementary motor cortices. J Neurophys. 2002;88(6):3498–517.
[26] Mudie MH, Matyas TA. Can simultaneous bilateral movement involve the undamaged hemisphere in reconstruction of neural networks damaged by stroke? Disabil Rehabil. 2000;22(1–2): 23–37.
[27] Hoare B, Imms C, Villanueva E et al. intensive therapy following upper limb botulinum toxin A injection in young children with unilateral cerebral palsy: a randomized trial. Dev med child neurol. 2013; 55(3):238-247.
[28] Yavuzer G, Selles R, Sezer N, et al. Mirror therapy improves hand function in subacute stroke: a randomized controlled trial. Arch Phys Med Rehabil. 2008; 89(3): 393–398.
[29] Fukumura K, Sugawara K, Tanabe S et al. Influence of mirror therapy on human motor cortex. Int J Neurosci. 2007; 117(7):1039-48.
[30] Mancini F, Longo M, Kammers M et al. Visual Distortion of Body Size Modulates Pain Perception. Psychological Science. 2011; 22(3): 325–330.
[31] Moseley G, Parsons T, Spence C. Visual distortion of a limb modulates the pain and swelling evoked by movement. Current Biology. 2008; 18(22):1047-1048.
[32] Kantak SS, Stinear JW, Buch ER et al. Rewiring the brain: potential role of the premotor cortex in motor control, learning, and recovery of function following brain injury. Neurorehabil Neural Repair. 2012; 26(3): 282–292.
[33] Garry M, Loftus A, Summers J. Mirror, mirror on the wall, viewing a mirror reflection of unilateral hand movements facilitates ipsilateral M1 excitability. Exp Brain Res. 2005; 163(1): 118-122.

Citation

Abo Nour, A. A., Saleh, M. G., & Elnagmy, E. H. (2016). IMPACT OF COMBINING MIRROR THERAPY AND HABIT ON HAND GRIP STRENGTH IN CHILDREN WITH HEMIPARESIS. *International Journal of Physiotherapy,* 3(4), 460-468.