Mirror Therapy Versus Cross Education on Wrist Extension and Hand Grip Strength in Children with Hemiparesis

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ABSTRACT

Background and purpose: *One of the most important activities of the daily life is the gripping function of the hand. Impaired hand function is a major disability in children with hemiparetic cerebral palsy (CP). The present study was conducted to determine the effect of mirror therapy versus cross education on wrist extension and hand grip strength in children with hemiparesis.* ***Subjects:*** *Thirty children with hemiparetic CP of both sexes (16 boys and 14 girls); their ages ranged from five to seven years (mean age 5.8 ± 0.86 years), represented the sample of this study. They had mild tightness in wrist flexors and they were able to stand unassisted and ambulate alone.* ***Methods:*** *Children representing the study sample were randomly divided into two groups of equal number; A and B. Group (A) received mirror therapy in addition to a traditional physical and occupational therapy program, while group (B) received cross education therapy in addition to the same physical and occupational therapy program given to group (A). Treatment was conducted 3 days a week for successive three months to both groups. Hand grip strength and angle of wrist extension were evaluated before and after treatment by using Hanoun medical system.* ***Results:*** *The post treatment results revealed a statistically significant improvement in the measuring variables of both groups as compared with its pre-treatment results. Also, significant difference was noticed in the measuring variables for the study group (A) when compared with study group (B) (P<0.05).* ***Conclusion:*** *The present study supports the ideas that mirror therapy and cross education improve hand function in children with hemiparesis, but mirror therapy has a more important value.*
Keywords: *Mirror Therapy, Cross Education, Wrist Extension, Hand Grip Strength, Hemiparesis.*

INTRODUCTION

One of the most important activities of daily life is the gripping function of the hand. The measurement of hand grip strength is used in physical therapy to assess the functional ability and the extent of rehabilitation of patients following injury or illness[1].

Hand grip is one of the most important functions of the hand. The hand may be used in a multitude of postures and movements in which most cases involves both the thumb and the other digits[2].

Wrist motion is essential for augmenting the fine motor control of the fingers and hand. Positioning the wrist in the direction opposite that of the fingers alters the functional length of the digital tendons so that maximal finger movement can be attained. Wrist extension is synergetic to finger flexion and increases the length of the finger flexors muscles and maximizing the contractual force of the digital flexors. Conversely, a posture of wrist flexion will markedly weaken grasping power[3].

For grip to be effective and have maximal force, the wrist must be stable and must be in slight extension and ulnar deviation[4]. Influence of wrist position on the force produced at the middle and distal phalanges revealed that the greatest force was generated with the wrist in ulnar deviation, the next greatest in extension, and the least in palmar flexion[2].

The major problem facing hemiplegic children is their inability to use their hands for reaching, grasping and manipulation. These problems affect many of the activities performed in their daily life such as dressing, eating, grooming and hand writing. In addition, upper extremity function plays an important role in gross motor skills like crawling, walking, recovering balance and protecting the body from injury when recovery is not possible[5].

Impaired hand function is a major disability in children with hemiplegic cerebral palsy. As a result, children with hemiplegic CP often fail to use the involved upper extremity and learn to perform most tasks exclusively with their noninvolved upper extremity (i.e. developmental disuse or "learned nonuse" effect). This disuse, in turn, may lead to additional impairments secondary to neural damage associated with CP[6,7].

The use of mirror visual feedback (MVF) is a simple non-invasive technique for the treatment of two disorders that have long been regarded as permanent and largely incurable; chronic pain of central origin (such as phantom pain) and hemiparesis following a stroke. A host of subsequent studies were inspired by these findings utilizing visual feedback conveyed through mirrors, virtual reality or, to some extent, even through intense visualization (which would be expected to partially stimulate the same neural circuits as the ones activated by MVF)[8].

Mirror therapy is a pioneering, non-invasive treatment for the rehabilitation of musculoskeletal and neuromuscular deficits. As the term implies, the primary tool of this therapy is a mirror from which the patient receives visual feedback in order to train the brain to configure a new body map. The ultimate goal of mirror therapy is to correct misrepresentations in the body map that develop when an injury or loss of limb occurs. Mirror therapy may hold promise as an effective treatment for other conditions. For instance, it is being explored as a potential treatment to facilitate recovery and help cortical reorganization following stroke, surgery, repetitive strain injuries, nerve injuries and other conditions[9].

The idea of mirror therapy is to use the mirror to produce the illusion for the patient that both limbs are intact. The effects of mirror therapy on upper-extremity motor recovery, and hand-related functioning of patients with subacute stroke were evaluated. It was found that hand functioning improved more after mirror therapy in addition to a conventional rehabilitation program compared with a control treatment immediately after 4 weeks of treatment and at the 6-month follow-up[10].

Cross-education has been defined as the performance improvement in the untrained limb after a period of unilateral exercise training. It has been accepted that cross-education can include the transfer of muscular strength to the untrained homologous muscle after a period of unilateral training and the transfer of motor skill learning to the untrained muscle[11]. Cross education is a neurophysiological phenomenon that occur due to factors both at muscular, spinal and neural levels[12].

It has an important implication for program design during rehabilitation of individuals with single limb injuries or in certain neurological disorders with predominantly unilateral muscle weakness. If exercising the healthy limb can strengthen the injured or diseased limb, this will potentially minimize complications caused by disuse and maximize the effectiveness of rehabilitation[11,13].

Cross education can occur with various training modalities (isometric or dynamic) and is governed by the principles of training specificity. In other words, the strength gain is confined to the homologous muscle of the opposite untrained limb, and the increase in strength is greatest during the same movement task performed by trained limb[14].

In this study, the hand grip strength and angle of wrist extension were assessed in an objective way through using computerized analysis system Hanoun 2002, as hand dynamometer and electronic goniometer which was used as an indicator for the accurate values of both variables. The Hanoun medical system characterized by its sensitivity, reliability and validity. The aim of this study was to investigate which is more effective, congruent visual feedback from the moving nonparetic hand, as provided by a mirror, or cross education therapy that would improve hand-related functioning of hemiparetic children.

MATERIALS AND METHODS

I- Subjects

Thirty spastic hemiparetic children (16 boys and 14 girls) were selected from the Outpatient Clinic of the Faculty of Physical Therapy, Cairo University.

The children were selected on the basis of the following criteria:

1- The age of the selected children ranged from 5 to 7 years old with a mean age of 5.8 ± 0.86 years.
2- The degree of spasticity ranged from 1 to 1 + grade according to the modified Ashworth scale[15].
3- They were able to understand and follow verbal commands and instructions included in both the test and treatment procedures.
4- None of them had any surgical interventions in the upper extremities.
5- They had mild tightness in wrist flexors. They had no other associated disorders or structural deformities in the affected upper limb.
6- They had neither visual nor auditory problems.
7- They were able to stand unassisted and ambulate alone.
8- All children were assigned randomly into two groups of equal numbers A&B. Group A (mirror therapy group): included 15 patients (7 males and 8 females) who received mirror therapy in addition to a traditional physical and occupational therapy program. Group B (cross education group): included 15 patients (9 males and 6 females) who received cross education therapy for the non affected upper limb in addition to the same physical and occupational therapy program given to group (A).

II- Instrumentation

A- For evaluation:

<u>Hanoun medical system:</u>

It was used to measure hand grip strength (hand dynamometer) and to measure the range of motion of wrist extension (electronic goniometer) (Fig. 1). This system consists of:

- Computer with 500 MHz processor.
- Data acquisition box.
- Specific software program called ODES 2002.
- Cables to connect hand dynamometer or goniometer to data acquisition box.
- Printer.
- Accessories for calibration.
- Aluminum hand grip with pressure transducer dynamometer to measure hand grip strength.

Goniomter with small arms for small joints and straps to fix both arms with child to measure the range of motion of wrist extension.

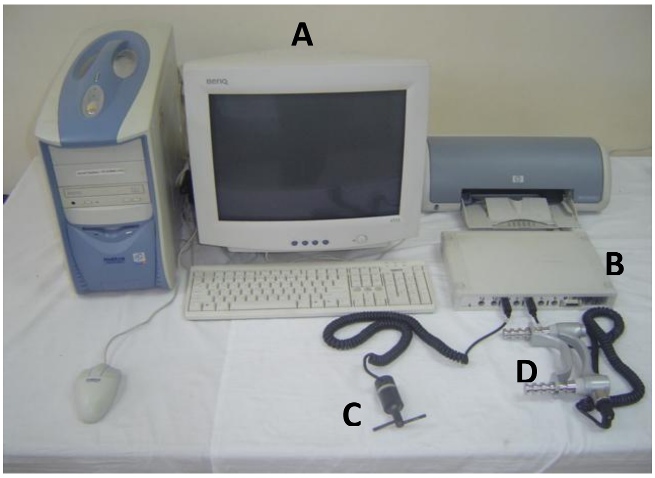

Fig. (1): Hanoun Medical System

A- Computer unit. B- Data Acquisition box.
C- Goniometer. D- Hand dynamometer

B- For treatment:

- Chairs and tables of adjustable height to allow the child to perform treatment program.
- Mirrors sized (35x35cm) made of plastic with a mirror coating,
- Motivational targets (toy or sweets) and different tools such as cubes, blocks, musical toys with different geometric shapes and sizes to encourage the child to perform the needed tasks.
- Mats, medical balls, rolls, and wedges were used for conducting the physical therapy program.

III- Methods:

A) For evaluation:

All children participated in this study were subjected to the following assessment:

1- Measurement of wrist extension range of motion:

Wrist extension of the affected arm of all children participated in this study were measured before starting treatment, and at the end of three months of treatment using electronic goinometer of the Hanoun medical system.

Each child was positioned in sitting, with adducted shoulder, flexed elbow 90 degrees and forearm pronation. Fulcrum of goniometer was placed just below the ulnar styliod process. The fixed arm was parallel to the ulna. The movable arm was parallel to the 5th metacarpal bone. The child was asked to move his/her wrist in extension and repeat that for three times. Finally the average range of motion was calculated using the electronic goinometer of the Hanoun medical system.

2- Measurement of hand grip strength:

Hand dynamometer of Hanoun medical system was used to measure the hand grip strength of the affected hand for all children participated in this study (Group A and B) before starting the treatment and at the end of three months of treatment.

Each child was positioned in sitting, with adducted shoulder, flexed elbow 90 degrees and forearm in mid position. Then the child was asked to hold the hand dynamometer in the tested (affected) hand without applying any force. After that when the apparatus was ready to measure the hand grip, the child was asked to squeeze the hand dynamometer as much as he/she can with steady force to reach maximal grip strength till the available time pass. Finally, the child was asked to release his / her grip and repeat that three times. Then the average force of the hand was calculated using the hand dynamometer of Hanoun medical system.

B) For treatment:

Both the mirror and cross education groups participated in a conventional physical and occupational therapy program for 3 successive months, 3 days/week, 2 hours/session. The conventional program is patient-specific and consists of Neuro-developmental facilitation techniques, and occupational therapy. Neuro-developmental facilitation techniques directed towards inhibiting abnormal muscle tone and abnormal movement patterns in addition to facilitating the normal patterns of postural control and gait training. Finally, the patients used these adaptive motor patterns as a basis for the development of skills and functional abilities. Patients of both groups received occupational therapy in the form of selected hand functions training program aiming to improve hand functions including grasping, releasing and transferring objects between hands via placing, sorting, building shapes, etc.).

1- The child was seated in a comfortable sitting position.
2- Table was adjusted to fit the child's height.
3- The child was asked to conduct different types of exercises including:

Forming tower of cubes of different colors, sorting similar colors and similar shapes together, e.g. square cubes together in a column, cylindrical cubes together, grasping molded cylinder rubber, hammer and different shapes of cubes and triangles. Placing balls in their column, circular shapes of different sizes in their right place and transferring objects between both hands.

Study group (A):

The children in this group received a mirror therapy program as follows: The mirror group patients were put on a practice schedule of an additional 30 minutes of mirror therapy program 3 days a week moving both hands or arms symmetrically. The learning table is made up of a mirror (35x35cm), fixed on a horizontal flat surface and was placed vertically perpendicular to the subject’s face. Through the mirror, the subject is able to look at the reflection of the healthy limb and focus on it, which becomes the virtual image of the paretic limb.

During the mirror practices, patients were seated close to the table. The involved hand was placed behind the mirror and the noninvolved hand in front of the mirror. The practice consisted of nonparetic-side hand opening and closing, wrist extension and flexion movements while patients looked into the mirror, watching the image of their noninvolved hand, thus seeing the reflection of the hand movement projected over the involved hand. During the session patients were asked to try to do the same movements with the paretic hand as much as they could while they were moving the nonparetic hand.

Study group (B):

For the same period, the cross education group performed the same exercises of wrist and finger flexion and extension movements for 30 minutes for the non affected side only.

RESULTS

Data analysis

The data obtained was statistically analyzed using: The mean and standard deviation for each variable, for both study groups before, after three months following the application of the treatment. Paired t-test was done to compare the pre and post treatment results for each group to determine the effect of each treatment. Independent t-test was done to compare the pre and post treatment results for both study groups.

(1) Wrist extension

For study group (A); there was significant difference in the mean values of wrist extension, when comparing its pre and post treatment mean values, as the mean values of wrist extension was (19.4 ± 2.4, Vs 8.06 ± 1.6 P<0.05), as shown in table (1) and figure (2).

For study group (B); Comparing the pre-treatment mean value of wrist extension with the post treatment mean value revealed significant difference, as the mean values of wrist extension were (17 ± 2.1, Vs 7.73 ± 1.9 P<0.05), as shown in table (1) and figure (2).

Comparing the pre-treatment mean value of wrist extension for group(A) with the pre-treatment mean value of group (B) revealed no significant difference (P>0.05). The pre-treatment mean value of group (A) was 8.06± 1.66 while the mean value of group (B) was 7.73 ± 1.90. While Comparing the post treatment results of wrist extension between study (A) and study (B) groups, revealed a significant difference (P<0.05) in favor of study group (A). The post-treatment mean value of group (A) was 19.4 ± 2.4, while the post-treatment mean value of group (B) was 17 ± 2.1 as represented in table (1) and figure (3).

Table (1): Comparison of pre and post-treatment mean values of wrist extension (degrees) within groups and between groups.

	Time of evaluation for wrist extension			
	Pre X±SD	Post X±SD	t-value	P-value
Study Group (A)	8.06± 1.66	19.4 ± 2.4	44.97	0.0001†
Study Group (B)	7.73 ± 1.90	17 ± 2.1	30.86	0.0001†
t-value	0.509	2.86		
P-value	0.614	0.007*		

†P <0.05compared before treatment (*Pre*) and after 3 months (*Post*)within groups
*P<0.05compared at 3 months (*Post*) between study (A) and study (B) groups

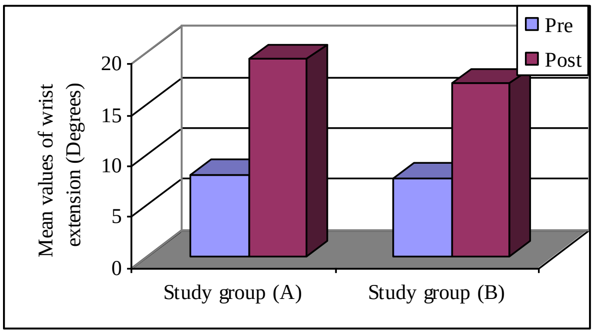

Fig. (2): Illustrating the pre and post-treatment mean values of wrist extension (degrees) for the study group (A) and the study group (B).

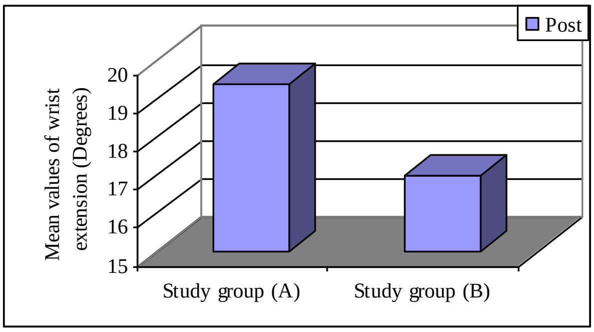

Fig. (3): Illustrating the post-treatment mean values of wrist extension (degrees) for the study group (A) and the study group (B).

(2) Hand grip strength

For study group (A); there was significant difference in the mean values of hand grip strength, when comparing its pre and post treatment mean values, as the mean values of hand grip strength were (10.63 ± 1.49, Vs 5.7± 1.42 P<0.05), as shown in table (2) and figure (4).

For study group (B); Comparing the pre-treatment mean value of hand grip strength with the post treatment mean value revealed significant difference, as the mean values of hand grip strength were (9.35 ± 1.56, Vs 5.66 ± 1.26 P<0.05), as shown in table (2) and figure (4).

Comparing the pre-treatment mean value of hand grip strength for group (A) with the pre-treatment mean value of group (B) revealed no significant difference (P>0.05). The pre-treatment mean value of group (A) was 5.7 ± 1.42 while the mean value of group (B) was 5.66 ± 1.26. While Comparing the post treatment results of hand grip strength between study (A) and study (B) groups, revealed a significant difference (P<0.05) in favor of study group (A). The post-treatment mean value of group (A) was 10.63 ± 1.49, while the post-treatment mean value of group (B) was 9.35 ± 1.56, as represented in table (2) and figure (5).

Table (2): Comparison of pre and post-treatment mean values of hand grip strength (Kg) within groups and between groups.

	Time of evaluation for hand grip strength			
	Pre X±SD	Post X±SD	t-value	P-value
Study Group (A)	5.7± 1.42	10.63 ± 1.49	69.6	0.0001†
Study Group (B)	5.66± 1.26	9.35 ± 1.56	19.87	0.0001†
t-value	0.081	2.29		
P-value	0.935	0.029*		

†P <0.05compared before treatment (*Pre*) and after 3 months (*Post*)within groups
* P<0.05compared at 3 months (*Post*) between study (A) and study (B) groups

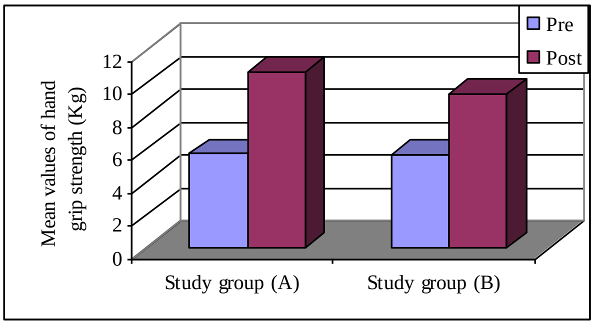

Fig. (4): Illustrating the pre and post-treatment mean values of hand grip strength (Kg) for the study group (A) and the study group (B).

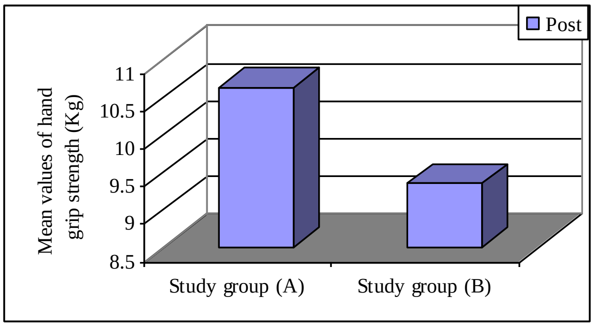

Fig. (5): Illustrating the post-treatment mean values of hand grip strength (kg) for the study group (A) and the study group (B).

DISCUSSION

Hand skills are vital to the child's interaction with the environment. Engagement in most occupations requires object handling, almost all of which is accomplished with the hands. Children with a wide variety of types of disabilities are likely to have difficulty with hand function. These disabilities include cerebral palsy[16].

Spastic hemiplegia is characterized by spasticity in the arm, leg and trunk on one side of the body and most walk independently but there is a wide variation in the function of the affected arm and hand[17].

The aim of this study was to compare between the effect of mirror therapy and cross education training on improving hand grip strength and wrist extension in hemiparetic children.

The obtained pre-treatment data may be attributed to the dependence of hemiparetic child on his/her uninvolved hand to accomplish most activities of daily living (ADL), while the involved hand serve as helper in the bimanual activities, this neglection might increase the weakness of the affected upper extremity and so reduces the amount of muscle tension which in turn reduces normal functional activities of motor neurons[18].

The results of the present study revealed that, both mirror therapy and cross education had significant effect on improving hand grip strength and wrist extension. However, high significant improvement was observed in the results of the measuring variables in favor of mirror therapy group.

Several underlying mechanisms for the effect of mirror therapy on motor recovery have been proposed. For example, Altschuler[19] reported that range of motion (ROM), speed, and accuracy of arm movement were more improved after mirror therapy in 9 chronic stroke patients. He suggested that the mirror illusion of a normal movement of the affected hand may substitute for decreased proprioceptive information, the mirror provides patients with “proper” visual input thereby helping to recruit the premotor cortex and assisting rehabilitation through connection between visual input and premotor areas. On a number of neurological and psychological levels, mirror therapy may help to reverse elements of learned disuse of the affected limb.

The obtained results of (mirror therapy) group come in agreement with Stevens and Stoykov[20] who reported that their stroke patients who trained with mirror therapy for 3 to 4 weeks had an increase in active ROM, movement speed, and hand dexterity after mirror therapy. They suggested that mirror therapy related to motor imagery and that the mirror creates visual feedback of successful performance of the imagined action with the impaired limb. Motor imagery itself, the mental performance of a movement, has proven to be potentially beneficial in the rehabilitation of hemiparesis[21].

In an interesting study in normal subjects Garry et al.,[22] used transcranial magnetic stimulation (TMS) during mirror visual illusions in healthy subjects to look at excitability of the motor cortex ipsilateral to a moving hand. They studied four conditions: (i) subjects watching the hand they were moving; (ii) subjects watching their inactive hand; (iii) subjects watching a marked position between the moving and inactive hand; and (iv) subjects watching the reflection of the moving hand in a plane reflecting mirror. They found a significant increase in motor cortex excitability of the hand behind the mirror in the mirror viewing condition compared with the other conditions consistent with the mirror reflection exciting the motor cortex corresponding to the reflection of the moving hand.

In a recent review, Carson[23] explored the potential for bilateral interactions to occur in various brain regions, giving rise to functional improvements in the control of the paretic limb when movements are performed in a bimanual context. He suggested that when the nonparetic limb engaged during motor training, crossed facilitatory drive from the intact hemisphere will give rise to increased excitability in the homologous motor pathways of the paretic limb, facilitating recovery of function.

Similarly, The obtained results of (mirror therapy) group come in agreement with Sathian et al.,[24] who found that 2 weeks of intense mirror therapy in a chronic stroke patient resulted in a strong recovery of grip strength and hand movement in the paretic arm. In a recent randomized controlled trial, Sütbeyaz et al.,[25] showed an improved lower-extremity motor recovery and motor functioning in subacute stroke patients after 4 weeks of mirror therapy.

The obtained results of (mirror therapy) group come in consistent with Dhole et al.,[26] who reported that mirror therapy is a promising method to improve sensory and attentional deficits and to support motor recovery in a distal plegic limb. The mirror mechanism probably forms the neurophysiological basis for mirror therapy which has been shown to improve upper limb function in patients with stroke. This procedure gives visual illusion of movement of the paretic hand. This visual illusion seems to activate specific brain areas, that might have a positive effect on motor and sensory recovery.

The results of the present study concerning (mirror therapy) group come in agreement with Amimoto[27] who found that 14 hemiplegic patients, those who practiced ankle dorsiflexion using the mirror had more recovery of function in the affected limb than those who underwent direct conditioning. The changes associated with mirror conditioning using visual stimulation from the sound side underline the importance of the cognitive aspect of recovery as well as the physical.

On the other hand, the results of this present study revealed high significant improvement in group (B) who received cross education therapy. The results obtained in this group can be explained by the work of Yasuda and Miyamura[28] who reported vascular changes and strength gains in the contralateral untrained forearm after 6 weeks of unilateral gripping training (to fatigue). Maximal grip strength, muscle endurance (number of grip contractions before exhaustion) and peak blood flow increased not only in the trained limb, but also in the untrained limb.

This also come in an agreement with Zhou[29] who reported that four weeks of electromyostimulation (EMS) isometric knee extension training produced 21% of strength gain in both the trained and untrained limbs, whilst voluntary training produced 24% gain in the trained and 21% in the untrained limb. He suggested that candidates mechanisms include diffusion of impulses between cerebral hemispheres and co-activation of bilateral corticospinal pathways during unilateral training. All of these possible mechanisms would involve recruitment of untrained musculature during training of the opposite limb.

It is conceivable, that with repeated contractions over time functional changes may occur in these neural elements and subsequently change the way the contralateral limb is controlled. For example, Muellbacher et al.,[30] have shown that practice of simple repeated voluntary contractions can induce short-term changes in the primary motor cortex (M1). The site of neural adaptations that mediate cross education could reside in neural elements located ipsilateral and/ or contralateral to the trained limb.

The results obtained in this group can also be explained by the effect of unilateral voluntary contractions on alteration of the excitability of spinal and cortical motor pathways that project to the contra-lateral side, which would result in an increase in strength. It is possible that with repeated voluntary contractions, long-term functional re-organisation in these contralateral pathways may occur[31].

The findings of cross education group could be explained by the work of Hortobagyi et al.,[32] who stated that a number of mechanisms at different levels of the nervous system have been proposed for causing the phenomenon of cross-education. Voluntary muscle contraction can acutely change the contralateral motor pathway. When performed unilaterally, high-force voluntary contractions have been shown to have an acute and potent affect on the efficacy of neural elements controlling the exercised limb as well as the opposite, resting limb. During unilateral voluntary contractions, as well as activation in the hemisphere contralateral to the contraction, the ipsilateral sensory and motor cortical areas are activated.

Within the context of "motor learning", it is well known that practicing a given motor task with one limb can improve the performance of the same task when executed by the opposite homologous limb. This bilateral or "interlateral" transfer of motor learning has been demonstrated in various skill tasks such as drawing, writing, ball catching, pointing tasks, tactile acuity and skillful operation of an upper-limb prosthetic stimulator[33].

Comparing the pre and post –treatment results of the affected upper limb of the (cross education) group revealed significant improvement which may be attributed to the effect cross education, these findings come in agreement with Teixeira and Caminha[34] who found that practice of a motor skill with muscles on one side of the body can improve performance of the skill with the corresponding muscles on the other side of the body.

The post treatment results of this group can be explained by the work of Carroll et al.[12] who found that increase in peak blood flow in the untrained forearm may be secondary to the release of neurogenic or metabolic vasodilators in response to exercise. It was argued that the increase in peripheral blood flow in the contralateral untrained limb may be partly responsible for the cross transfer of strength and endurance.

From the previous discussion, the results of this study support the idea that mirror therapy and cross education therapy improve hand grip strength and wrist extension, but mirror therapy has a more important value. There are some possible explanation according to the reports of the investigators in the field related to the present study, which could justify the effectiveness of mirror therapy than cross education. This may be due to the effect of mirror neurons that are bimodal visuomotor neurons which are active during action observation, mental stimulation (imagery), and action execution. Mirror neurons necessarily involve interactions between multiple modalities—vision, motor commands, proprioception—which suggest that they might be involved in the efficacy of MVF[35].

Mirror neurons are now generally understood to be the system underlying the learning of new skills by visual inspection of the skill. In patients with brachial plexus avulsion, Giraux and Sirigu[36] used a virtual reality system displaying prerecorded movements of a hand to create the illusion of normal hand movement. During an 8-week training program, patients were asked to try to match the movement of the unseen involved hand with the displayed hand movements. After the training period, through the use of this artificial visual feedback it becomes possible for the patient to move the paretic limb in the desired action. An increased activity in motor cortex corresponding with the affected limb was found using functional magnetic resonance imaging.

In a recent pilot study, brain areas that are involved in sensory-motor learning (mirror neurons), are activated by the visual illusion from mirror therapy. Conventional therapies for hemiplegic limbs use active or passive physical exercise in an attempt to stimulate new neural connections that lead to recovery. The addition of mirror therapy might enhance recovery by enlisting direct visual stimulation showing the affected limb working properly, rather than relying on mental imagery alone[27].

Another possible mechanism for the effectiveness of the mirror therapy might be bilateral arm training. In this study, patients were asked to move the paretic hand as much as they could while moving the nonparetic hand and watching its image in the mirror in a bilateral training approach. Summers et al.,[37] investigated the effectiveness of bilateral arm training and reported that compared with unilateral training, bilateral training intervention was more effective in facilitating upper-limb motor function in chronic stroke patients.

Conclusion

The results of this study suggested that mirror therapy should be used in addition to conventional therapy, as it is relatively effective, easy to do and easy to provide. Mirror therapy combined with the observation-imitation therapy could possibly represent a valid approach to augment the motor recovery of upper limbs and improving functional ability of hemiparetic children than cross training. This helped the hemiparetic CP children to use their affected hand so increasing their opportunity to receive sensory information from the environment and improving their performance in their daily living activities.

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الملخص العربي

دراسة مقارنة العلاج بالمرآة والتعليم المتبادل على فرد الرسغ وقوة قبضة اليد لدي الأطفال المصابين بالفالج الشقي

المقدمة والغرض : تعتبر الوظيفة القابضة لليد من أهم وظائف الحياة اليومية وتهدف هذه الدراسة إلى مقارنة العلاج بالمرآة والتعليم المتبادل على فرد الرسغ وقوة قبضة اليد لدي الأطفال المصابين بالفالج الشقي . **عينة البحث :** أجريت هذه الدراسة على ثلاثين من الأطفال المصابين بالفالج الشقي تراوحت أعمارهم من خمسة إلى سبعة سنوات ويعانون من قصر بسيط في عضلات الرسغ القابضة وقادرين على الوقوف والمشي بمفردهم . **طرق البحث :** تم تقسيم هؤلاء الأطفال عشوائيا إلى مجموعتين متساويتين في العدد ، مجموعة الدراسة (أ) ومجموعة الدراسة (ب) . تلقت مجموعة الدراسة (أ) برنامج العلاج بالمرآة بالإضافة إلى برنامج العلاج الطبيعي والوظائفي التقليدي ، بينما تلقت مجموعة الدراسة (ب) برنامج التعليم المتبادل بالإضافة إلى نفس برنامج العلاج الطبيعي والوظائفي المطبق لمرضى المجموعة (أ) . استمرت الدراسة ثلاثة أشهر بواقع ثلاث جلسات أسبوعيا . تم تقييم زاوية فرد الرسغ وقوة قبضة اليد باستخدام جهاز قياس قوة قبضة اليد الالكتروني قبل وبعد ثلاثة أشهر من العلاج لكل من المجموعتين . **النتائج :** أثبتت النتائج أن هناك فروق ذات دلالة إحصائية على المجموعتين عند مقارنتهما بالنتائج الأولية قبل إجراء البحث . كذلك وجود فروق ذات دلالة إحصائية واضحة على نتائج المجموعة الأولى (أ) عند مقارنة نتائج العلاج للمجموعتين . **المناقشة والملخص :** نستنتج من هذه الدراسة أن العلاج بالمرآة أو التعليم المتبادل يعطى نتيجة طيبة على تحسين زاوية فرد الرسغ وقوة قبضة اليد ولكن العلاج بالمرآة له تأثير أكثر فعالية من التعليم المتبادل .

الكلمات الدالة: العلاج بالمرآة ، التعليم المتبادل ، فرد الرسغ ، قوة قبضة اليد ، الفالج الشقي .