

# Effect of Strengthening Exercises of Shoulder Muscles on Hand Functions in Spastic hemiplegic Cerebral Palsied Children

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## ABSTRACT

**Objective:** To determine the effect of strengthening exercises of shoulder muscles on hand functions in spastic hemiplegic cerebral palsied children.

**Methods:** The study was carried out on thirty spastic hemiplegic children of both sexes (15 females and 15 males) divided into equal groups A and B. Their age ranged from six to ten years old. The muscular strength of shoulder flexors and extensors were evaluated by Biodex isokinetic dynamometer. Their hand functions were evaluated by using Peadody developmental motor scales(PDMS).prior and after six months of rehabilitation program. Group A received the traditional physiotherapy program. While group B received strengthening exercises program for shoulder muscles in addition to the traditional physiotherapy program .

**Results:** Patients of group (B) improved in age equivalent of grasping by 42.4% with SD 1.27±0.46, Values of peak torque (flexion) improved 8.9 with SD 10.29±1.04 and values of peak torque (extension) improved 1.57 with SD 9.92±0.63

**Conclusion:** The study showed significant improvement in group B more than group A. for age equivalent of grasping and peak torque of flexors and extensors of shoulder muscles.

**Keywords:** Strengthening, Exercises, Hand functions and Spastic Hemiplegic

## INTRODUCTION

Cerebral palsy is defined as a group of permanent disorders of the development of movement and posture, causing activity limitations that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behaviour, by epilepsy and by secondary musculoskeletal problems<sup>1</sup>

Cerebral palsy can be divided into four types based on motor dysfunction: spastic, ataxia, athetotic, and mixed<sup>2-9</sup>. Rehabilitation through voluntary movement is mostly suit-able for children with spastic cerebral palsy<sup>10-12</sup>; thus, this study focused on the spastic gait. The major problem facing the hemiplegic children is the inability to use their hands to reach, grasp, release of objects and hand manipulation, In addition to , upper extremity function plays an important in gross motor skills like crawling, walking, recovering balance and protecting the body from injury when recovery is not possible<sup>13</sup>.

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Hand function depend on effective stabilization of shoulder, elbow and wrist.<sup>14</sup>. Sufficient strength is necessary to initiate all types of grasps patterns and to maintain these patterns during carrying. Children with poor strength may be unable to initiate the finger

extension or the thumb opposition pattern necessary before grasp. They also may not have the flexor control to hold a grasp Pattern <sup>15</sup>. sufficient proximal stability control is integrated with the acquisition of motor milestone <sup>16</sup>.

This study aimed to determine the effect of strengthening exercises of shoulder muscles on hand functions of spastic cerebral hemiplegic children.

### MATERIALS AND METHOD

This study was conducted at the outpatient clinic of the Faculty of Physical Therapy, Cairo University. Thirty hemiparetic children from both sexes (15 girls and 15 boys). Their age ranged from five to seven years, age (mean  $\pm$  standard deviation) of groups (A) and (B) were  $5.83 \pm 0.49$  and  $5.93 \pm 0.69$  years; respectively. The degree of spasticity ranged from 1 to 1+ according to the Modified Ashworth Scale <sup>17</sup>. Children were assigned randomly into two groups of equal number. Hand functional skill (Age equivalent of grasping) measured by Peabody Developmental Motor Scale (PDMS- 2) and Peak torque of shoulder flexors and extensors measured by Biodex Isokinetic Dynamometer in children in both group before and after treatment.

#### Treatment Procedure

Patients were divided randomly into two groups with equal numbers ( group A received traditional physiotherapy program for one hour, three session per week for six months) While group B received functional strengthening exercises program for shoulder muscles for half hour, three session per week for Six months in addition to the traditional physiotherapy rehabilitation program for half hour, three session per week for six months. The traditional physical therapy program was directed towards inhabiting abnormal muscle tone and abnormal postural reflexes and facilitating normal motor patterns of postural control by using: keys point of

control of Bobath technique. Specially Designed postural Control training program; exercises for antigravity mechanism, exercises for the righting , equilibrium reactions and protective reactions. Exercises in standing with concentration of the weight on the affected leg. Proprioceptive Training: Approximation and weight bearing exercises. The functional strengthening exercises program for shoulder muscles consisted of reaching toy in front of him and hold this position for 5 sec, reaching toy above level of shoulder level and hold for 5 sec, grasping cup and ask him to release cup in basket in front of him level, grasping cup and ask him to release cup in basket above shoulder level, reaching toy in front of him with sand bag above elbow, reaching toy above shoulder level with sand bag above elbow, reaching toy in front of him with sand bag below elbow, reaching toy above shoulder level with sand bag below elbow, reaching toy in front of him with sand bag above elbow with hold for 5 sec at the end of the position.,reaching toy above level of shoulder with sand bag above elbow with hold for 5 sec at the end of the position.

### RESULTS

#### I – Age equivalent of grasping

As shown in table ( 1) a t test for paired samples (difference between pre-treatment and post-treatment measures) indicated that subjects included in group A improved after traditional physiotherapy program with respect to age equivalent of grasping (mean [ $\pm$ SD] post-intervention measurement of  $6.67 \pm 1.18$  versus mean pre intervention measurement of  $6.07 \pm 0.79$  , $P < 0.05$ ). group B subjects significantly improved after the functional strengthening exercises program for shoulder muscles in addition to the traditional physiotherapy program with respect to age equivalent of grasping (mean [ $\pm$ SD] post-intervention measurement of  $9.87 \pm 2.2$ ) versus mean pre intervention measurement of  $( 6.93 \pm 1.1$  ,  $P < 0.05$ ).

Table(1): Mean values of age equivalent in group A and B:

Groups	Age equivalent (months)	MD	Improvement %	T value	Pvalue	Significance
	X $\pm$ SD					
Group A Pre Post	$6.07 \pm 0.79$ $6.67 \pm 1.18$	0.6	9.88	3.67	<0.05	S
Group B Pre Post	$6.93 \pm 1.1$ $9.87 \pm 2.2$	2.94	42.42	6.64	<0.05	S

II – Peak torque of Shoulder muscles (flexion and extension)

As shown in table (2) Group A. the peak torque of Shoulder flexor muscles improved with(mean [±SD] post-intervention measurement of 8.83±1.05N m versus mean pre intervention measurement of 8.7±1.02

N m, P <0.05) Group B. the peak torque of Shoulder flexor muscles improved with(mean [±SD] post-intervention measurement of 10.29±1.04 N m versus mean pre intervention measurement of 9.45±0.78 N m, P <0.05).

**Table (2): Mean values of peak torque (flexion) (N.m) in group A and B:**

Groups	Age equivalent (months)		MD	Improvement %	T value	Pvalue	Significance
	X ±SD						
<b>Groups A PrePost</b>	8.7±1.02	8.83±1.05	0.13	1.5	4.39	<0.05	S
<b>Group B PrePost</b>	9.45±0.78	10.29±1.04	0.84	8.9	9.1	<0.05	S

**(B) Peak torque (extension)**

As shown in table (3) Group A. the peak torque of Shoulder flexor muscles improved with(mean [±SD] post-intervention measurement of 8.17±0.63 N.m

versus mean pre intervention measurement of 7.97±0.6 N m, P <0.05) Group B. the peak torque of Shoulder flexor muscles improved with(mean [±SD] post-intervention measurement of 9.92±0.63N m versus mean pre intervention measurement of 8.35±0.72 N m, P <0.05).

**Table (3): Mean values of peak torque (extension) (N.m) in group A and B:**

Groups	Age equivalent (months)		MD	Improvement %	T value	Pvalue	Significance
	X ±SD						
<b>Group A PrePost</b>	7.97±0.6	8.17±0.63	0.2	2.51	7.79	<0.05	S
<b>Group A PrePost</b>	8.35±0.72	9.92±0.63	1.57	18.8	6.15	<0.05	S

**DISCUSSION**

Spastic hemiparetic children exhibit abnormal synergies of movement including deficits that interfere with various motor functions such as gross and fine motor skills. This comes in agreement with Lepage et al.,<sup>18</sup> who stated that, children with cerebral palsy suffer from neurological deficits that interfere with motor function. These impairments include neuromuscular and musculoskeletal problems as spasticity, muscle contracture, in coordination, defective motor control and muscle weakness. Also, such children may show a delay in the acquisition of various motor functions such as gross and fine motor skills and this consequently, interfere with the hand function. Myres<sup>19</sup> and Schneck<sup>20</sup> who revealed that, by the age of six years; the grasp patterns become fully matured. Case-Smith<sup>21</sup> confirmed that, by the age ranging between five and seven years, the child can assume hand grip with regular force either to grasp or to lift the object without letting it slipping through the fingers. The pretreatment values of age equivalent of grasping in groups (A) and (B) were significantly lower than their peer age as a results of undeveloped motor cortex and corticospinal pathway lead to undeveloped skilfully fingers movements due to increase of upper limbs spasticity or tactile or proprioceptive disturbance that agree with<sup>22</sup> and<sup>23</sup> Who reported that fine movement or tasks requiring manipulation, children with CP were slow in their finger movement and clumsy. The

lowered age equivalent values in hemiplegic children may be due to mirror movement (unnecessary movement associated with voluntary movement in some group of muscles but on the opposite side of the body These mirror movements occur in distal parts of upper limbs during repetitive finger and hand movements that agree with<sup>24</sup> who reported that mirror movements occur due to abnormal inhibitory connections and over activities of ipsilateral motor cortex.

The results of the present study showed significant improvement in age equivalent of grasping in hemiplegic children in group (B) after hand function training program as results of the fact the nervous system have the abilities to compensate lost function as the healthy brain cells can compensate the dead cells. The functional strengthening exercises program for shoulder muscles was directed to facilitate hand function through many tasks involving reach, grasp, release and other manipulative skills. These agree with Bulter<sup>25</sup> who confirmed that the aim of physical therapy should promote movement control and functional abilities through effective means.

During rehabilitation of hand functions, the child was encourage to perform the task as a part not as a whole (Task analysis) which explain increase in age equivalent of grasping after the intervention(part versus the whole) .This come in accordance with<sup>26</sup> who

reported that fine motor tasks improves through specific strategies through great deal of repetition. On the other hand our findings for improvement of hand functions is contra indicated<sup>27</sup> who reported that no scientific evidence existed to supported the use of neurodevelopmental techniques for alternating neurological development in handicapped children.

The pretreatment mean values of peak torque shoulder flexors in both group (A) and (B) were significantly lower than their peer children in the same age due to abnormal contraction of muscles around the shoulder joint, increase plasticity of in these muscles and increase collagen content which reduce amount of muscle tension. This findings come in agreement with<sup>28</sup> who found spasticity of hemiplegic children may be reduce power, load force and the inter joint coordination of the affected upper limb muscles.

The results obtained from both groups (A) and (B) showed significant improvement in mean values of peak of flexors muscles in group (B) more than group (A) which may be due to functional strengthening exercises of the shoulder muscles that lead to increase number of sarcomeres that improves the amount of muscular contraction and reciprocal innervation improved the amount of tension in weaker muscles from stronger one. This comes in agreement with Tax<sup>29</sup> who stated that when strengthening exercises were applied to a certain muscle, the power was improved as well as the power of the muscles acting in the same group or same limb and have the same synergies acting on a certain movement. Improvement in performance observed in the post treatment results comes in agreement with the results of Burridge and Man<sup>30</sup> who concluded that to provide more functional arm movement

### CONCLUSION

Strengthening exercises of shoulder muscles have significant effect on improving hand functions in the affected upper limb of spastic hemiplegic cerebral palsied children

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### Ethical Consideration

All the ethical consideration has been taken care of for conduction of this study.

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