Comparison of Muscle Thickness between Normal and Hemiplegic Cerebral Palsy Children

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Abstract:

Background: children with spastic hemiplegia had disabilities of the upper extremities such as reaching, grasping, and object manipulation result in dependency in daily activities and a lack of successful social integration. Spasticity and decreased activity contribute to muscle weakness and imbalance, muscle atrophy resulting from disuse, muscle contracture, and a reduced range of motion in joints. **Purpose**: to compare muscle thickness in normal children and spastic hemiplegic cerebral palsy children. **Subjects and methods**: 35 children from both sexes with age range from 2 to 5 years included in this study and divided into two groups. Group (A) included 15 normal children and Group (B) included 20 children with hemiplegic cerebral palsy with spasticity grade 1 and 1+ according to Modified Ashworth scale. Subjects excluded from this study whom had any problems of the following: Recent skin injury, bony joint limitation, and children who take antiepileptic drugs or peak action is at the time of assessment of spasticity. Ultrasonography used to assess muscle thickness. **Results**: there was statistical significant difference between normal group and spastic group regarding muscle thickness of biceps brachii. **Conclusion**: According to the results we can conclude that muscle thickness of biceps brachii was lower than in age-matched normal children. Furthermore, it is noted with confidence that a significant positive correlation existed between muscle thickness and functional level.

Keywords: Cerebral palsy, Hemiplegia, Muscle thickness, Ultrasonography, Normal children.

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Introduction

Cerebral palsy (CP) is not a disease entity in the traditional term but a clinical description of children who have features of a non- progressive brain injury or lesion acquired during the antenatal, perinatal or early postnatal period. The clinical manifestations of cerebral palsy vary greatly in the type of movement disorders, the degree of functional ability, limitations and the affected parts of the body [1].

In spastic hemiplegic CP the involved limb is usually smaller and shorter than the other limb. It is not clear whether this difference is due to the brain injury, impaired nerve innervations and influence on growth factors, or reduced mechanical use. Several studies show muscle volume correlates with strength, and training is beneficial in CP [2].

Among children with unilateral CP, functional difficulties often manifest as problems with day-to-day activities, to which impaired upper limb skills contribute [3].

Individuals with hemiplegic CP generally are able to ambulate [4].Children with spastic hemiplegic cerebral palsy are restricted in their daily activities due to limited active ranges of motion of their involved upper limb Their impaired muscles are frequently targeted by anti-spastic treatments that reduce muscle tone [5].

Muscle thickness (MT), which can effectively reflect the muscle activities during muscle contraction. MT measurement is traditionally based on manual selection of 2 reference points at the superficial and deep aponeuroses [6].

Reduced muscle mass is another common impairment found in children with CP [7].

Ultrasonography is convenient technique to investigate muscle properties and has been widely used to look into muscle functions since it is non-invasive and real-time. Ultrasonography, as an important medical image modality in the study of the musculoskeletal system, has been widely used to measure changes in muscle geometry, such as muscle thickness, muscle pennation angle, fascicle length and cross-sectional area, because it is versatile, inexpensive and radiation-free [8] .

Subject, materials and methods

Study design: comparative study between normal and spastic hemiplegic CP.

This study was held between August 2018 and November 2018. Prior to participation in the study, parents of selected children signed the written informed consent - ethical committee- Faculty of Physical Therapy P.T.REC|012|002058 and the aim and steps of the task were explained to them. Two study groups normal group and hemiplegic group were assessed by ultrasonography.

Participants:

Thirty five children from both sexes were recruited from the Outpatient clinic of the Faculty of Physical Therapy and AL-Minia physiotherapy clinic and divided into two groups. Group (A) included fifteen normal children and group (B) included twenty hemiplegic children with degree of spasticity 1 and 1+ according to modified ashowrth scale. Muscle thickness was assessed by ultrasonography in both groups to compare difference if present. **Inclusion criteria:** Age ranged from 2-5 years chronologically. children diagnosed as hemiplegic and spasticity degree was ranged from grade 1 to grade1+ according to Modified Ashworth Scale (MAS) **Exclusion criteria:** Subjects excluded from this study whom had any problems of the following: Recent skin injury, bony limitation of range of motion, previous history of muscle trauma, previous history of surgical intervention of the upper extremities, and children who take antiepileptic drugs or peak action occur at the time of assessment of spasticity. The age-matched children who included in study were noted with normal developing muscles. Potential participants were excluded if they had any developmental disorder affecting the upper limbs.

Measurement procedures:

1- **Modified Ashworth scale (MAS)**: for selection of hemipelgic cerebral palsy children.

2- Ultrasonography: 7.5MHz ultrasound transducerprobe (Serial number AGC73124954) (MindrayDP-10) to measure muscle thickness of the Biceps Brachii.

Fig. (1) Ultrasonography for biceps muscle.

Procedures:

1- Evaluation of spasticity

By using the modified Ashworth scale the children with hemipelgic cerebral palsy were evaluated to detect the degree of spasticity (grade 1 and 1+).

2-Measurement of muscle thickness:

By using ultrasonography device to measure the muscle thickness of the biceps brachii muscle. At first, the child was positioned in supine with extended elbow. A longitudinal section image was taken by ultrasonography for the biceps muscle while the researcher was seated beside the patient to support the upper limb as needed. After capturing the images by ultrasonography, the researcher measured Muscle thickness by measuring a distance by drawing a vertical line between the superficial aponeurosis and the deep aponeurosis fig (1, 2).

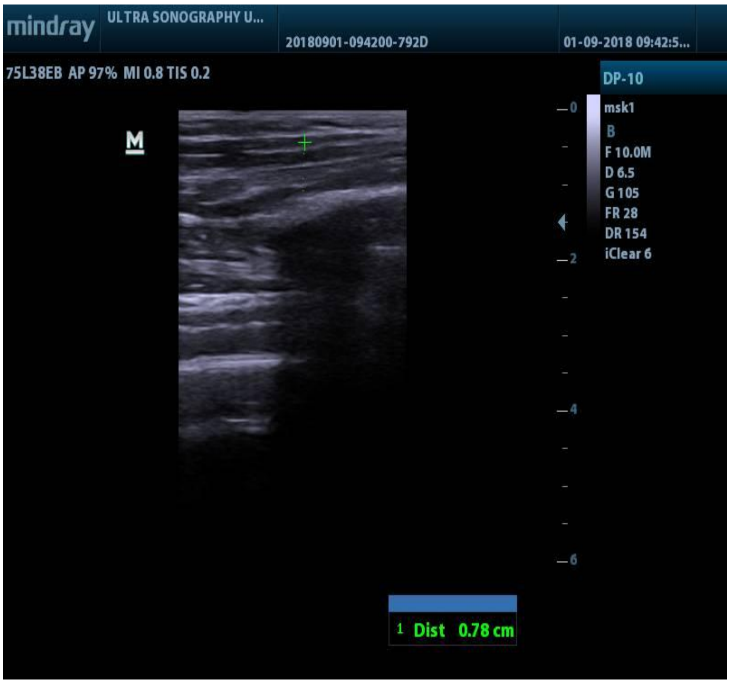

Fig. (2): Measurement of muscle thickness of biceps muscle by ultrasonography.

III. Data Analysis

Statistical Package for Social Sciences (SPSS) computer program (version 24 windows) was used for data analysis. P value ≤ 0.05 was considered significant. Unpaired t-test was used to identify changes and significant differences between both groups.

Results

Results:

Table (1): Comparison between ages of the both groups (normal and spastic)

Age(years)	Normal (n= 15)	Spastic hemipelgia (n= 20)	t value	P value
Mean ± SD	3.805 ± 0.589	3.8 ± 0.763	0.022	0.9822 (NS)

Data are expressed as mean ± SD. NS= p> 0.05= not significant.

2. Comparison of muscle thickness between both groups (normal and spastic)

There was a statistical significant difference between the mean value of muscle thickness of biceps brachii muscle in normal group (1.387 ± 0.277) and its corresponding thickness of spastic group (1.048 ± 0.317) with t value= 3.3065 and p value= 0.0023 as shown in table (2).

Table (2): Comparison between mean values of muscle thickness of biceps brachii in normal and spastic groups:

Muscle thickness	Normal (n= 15) Mean ± SD	Spastichemiplegia (n= 20) Mean ± SD	t value	P value
Biceps brachii muscle thickness	1.387 ± 0.277	1.048 ± 0.317	3.3065	0.0023 (S)

S= p< 0.05= Significant

Discussion

The aim of the study to find out If there is difference between hemiplegic and normal children regarding to muscle thickness. Muscle thickness (MT) is an indicator of muscle mass, possibly reflects the level of activity of daily life (ADL), because reduction in physical activity by various impairments decreases muscle mass. Although the ordinary measurement of muscle strength is difficult in individuals with cerebral palsy, muscle thickness is applicable to them. These results validate MT as a quantitative muscle evaluation method with clinical utility across a broad spectrum of individuals with CP [9].

Ultrasonography is a useful method for muscle imaging and has been used to measure the deep fascicle angle and length in individuals with CP [10].

Ultrasonography has been used to measure changes in muscle thickness, muscle fiber pennation angle during static and dynamic contractions [11]**.**

the results of current study are consistent with mockford and Caulton, 2010 who concluded that normal muscle is composed of 95% fibers, spastic muscle is only 40% fibers, with increased intramuscular fat and connective tissue. Skeletal muscles are subject to reshaping in the body and can be adapted by a variety of positive and negative stimulations, such as strength training, disuse, spasticity, and immobilization [12, 13].

Data in both animal and human models studied by **Bland et al., 2011** and **Noble et al., 2014** which have shown that muscle size and fascicle length become smaller in response to disuse and immobilization [14, 15].

This effect on muscle thickness and fascicle length may contribute to muscle weakness and imbalance [16, 17, 18, 19].

An increasing number of studies have reported that muscle thickness is smaller and fascicle length is shorter in the gastrocnemius muscle in children with spastic CP. **Damiano et al., 2000 and Mathewson, 2015** suggested that a reduction in muscle size during childhood could contribute to the deterioration of mobility observed in teenagers and adults with spastic CP. The similar findings reported in the present study suggest that the decrease observed in muscle thickness and fascicle length in biceps of CP patients might be the result of spasticity, disuse and limited activity. The timing of onset of secondary impairments remains unclear in children with CP [20, 21].

A previous study suggested that muscle changes could occur at an earlier age than is generally believed [22]. Thus, it is very important for children with CP to perform early targeted activities to optimize these adaptive changes in muscle architecture and function. The results of this study revealed that the thickness of the affected biceps is associated with lower mobility and even atrophy. These effects may result in muscle fibrosis, which can decrease muscle strength and contraction elasticity [23].

Decreased muscle strength has also been observed in children with CP, suggesting limited activation [24]. This lack of activation and plasticity could compromise the muscle [25].

Specific activation patterns may induce substantial fiber type plasticity and result in smaller muscle thickness in children with CP [26, 27, and 28]. Studies have suggested that targeted strength training should be implemented in these children to reverse the progress of muscle disuse and atrophy, to support the development of the corticospinal system, and to increase muscle recruitment [29, 30].

The results of the current study don't agree **Yang et al., 2014** who found that the muscle architecture parameters (pennation angle and muscle thickness) were higher in the spastic group more than the non spastic [31]. A linear relationship between muscle activity and changes in muscle geometry has been reported for certain muscles as biceps and medial gastrocnemius. For muscles that behave in this manner, sonographic measurement may be useful over a wider range of contractions. Importantly, there is no relatioship between muscle thickness and muscle activity for some muscles as obligus externus, so ultrasonographic measures of thickness cannot be used to detect activity in these muscles [32]. The results of the current study comes in agreement with **Yasar et al., 2014** who found that the affected side of stroke patients showed reduced muscle thickness and fascicle length compared to the unaffected side [33].

Conclusion:

Finally there are significant difference of muscle thickness between normal and children with hemiplegic cerebral palsy that may need additional therapeutic program to improve muscle strength and function.

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