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RESEARCH ARTICLE

HAND GRIP IN RELATION TO CUBITUS VALGUS DEFORMITY IN CHILDREN WITH HEMIPARETIC CEREBRAL PALSY

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ABSTRACT

The purpose of this study was to determine the relationship between hand grip and cubitus valgus in hemiparetic cerebral palsied children.

Subjects and procedures: 25hemiparetic cerebral palsied children (boys and girls) between7 and 9years of age were selected to participate in this study. Cubitus valgus was measured by a universal goniometer and a handheld dynamometer to test for hand grip strength.

Results: By comparing both affected and unaffected sides, it was revealed that there was a significant correlation in both variables of hand grip and carrying angle; however using the Spearman's rank correlation coefficient test, there was no significant correlation found between hand grip strength in an affected hand and the carrying angle in an affected upper arm.

Conclusion: Hand grip muscle strength was reduced and directly affected by the carrying angle in both the affected and unaffected upper arms as a result of the valgus position was of positive correlation with hand grip, meaning that a hemiparetic hand grasps all objects with an exaggerated opening throughout the entire movement without an anticipatory grasp formation which later the hand grip will be directly affected by the degree of cubitus valgus angulation.

INTRODUCTION

The elbow and lower arm complex comprises three bones (the humerus, ulna, and radius) and four joints (humeroulnar, humeroradial, proximal radioulnar, and distal radioulnar) (Neumann, 2002). The upper arm and lower arm measurement do not forma straight line; instead, there is obliquity between the upper arm and the supinated lower arm when the elbow is held in extension (Schoen, 2006). The carrying angle measures 5–10 degrees in men and 10–15 degrees in women. It is greater in women than it is in men and it impacts how objects are held by people; subjects who have cubitus valgus will probably supinate the lower arm when they grasp objects with a specific end goal of keeping the elbows nearer to the body. An expansion in this point above typical (because of the horizontal deviation of the lower arm) is referred to as cubitus valgus (Karen, 2007) Hemiplegic cerebral paralysis which incorporates the association of one side of the body with an upper appendage that is more affected than the lower appendage is the commonest sort (30%) of spastic cerebral palsy in youngsters (Wilsdon, 1996).

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In hemiparetic cerebral palsied children spasticity meddles with the ordinary capacity of the upper limb by creating an expansion in the tone of the flexor and extensor muscles; consequently, there are difficulties with reach, grasp and control (Carmick, 1997) since hemiplegic children with hand grip problems are obliged to utilize their wrist flexors instead of finger flexion. This discoordinate activity interferes with the compelling force of the fingers (Brown *et al*., 1996). The hand is viewed as the essential method of interaction with one's physical environment. The hand is unimaginably flexible. It can be a platform, a hook or aneedle grip. Moreover, it can investigate objects, express feelings, or language (Exner, 1996).The hand is a viable apparatus utilized to carry out various activities in everyday life (Exner, 2001). The hand is considered a person's primary means of physical engagement, both through the dexterous grasp and manipulation of objects and as an enabler of multiple tool function (Exner, 1996). The hand is used in a variety of ways (Exner, 2001). The power grasp utilizes finger flexion and by hollow rounded grip. This is of great importance in training. In the first place, finger fractionation used with accurate grip) might be constrained. Second, control grasp playsan imperative part in holding and controlling capability of gripping of tools (Forssberg, 1991). In the event that the elbow flexors, similar to the biceps brachii, are active for the lower arm flexors, uneven pressure gathers in the soft tissue and results in elbow torment (Poliquin, 2006). The elbow joint permits one degree of freedom (flexion and extension), and the proximal radioulnar joint permits the supination and pronation of the forearm (Keith, 2006). The mechanical steadiness of the elbow joint is created by the congruency of the articulating surfaces, the supporting tendons, and additionally by the dynamic adjustment of the periarticular musculature (Wilk *et al*., 2003). Its serves as the mechanical connection in the furthest point between the hand, the wrist, and the shoulder. The elbow joint comprises three separate articulations: the ulnohumeral, radiocapitellar, and proximal radioulnar joints (Carol, 2004). When an individual is carrying object in one hand, they movethe upper arm at a slight horizontal pivot and the lower arm in supination (Schoen, 2006). After specific injuries of the elbow, the carrying point of the arm might extend away from the body.

This is called cubitus valgus, or excessive carrying angle of the arm (Chen, 2007). An extreme increase in the carrying angle is associated with elbow instability and pain during exercise or throwing sports (Hildebrand *et al*., 1999). It may also decrease elbow function and make the elbow vulnerable to dislocation (Yilmaz *et al*., 2005). The amount of force transmitted across the elbow joint depends on the loading configurations and the angular orientation of the joint (Maria *et al*., 2008). Measurement of the carrying angle is important in the diagnosis of disease in the lateral and medial epicondyles (Van Roy *et al*., 2005). A goniometer is an instrument that measures theangles of joints on an exact precise position (Nancy *et al*., 2009) when the elbow with the ulna demonstrates minimal sideway motion or to pivot with mid pronation and supination (Paraskevas *et al*., 2004). At the point when the lower arm is in extension the motion performed by coronoid process of the ulna press againstthe substandard end of the humerus, implying that the lower arm veers off radially and in this manner shapes the conveying point (Argiriadou and Paraskevas, 2006).In this study, we will investigate the effects of cubitus valgus deformity on hand grip strength.

METHODOLOGY

Twenty-five children with hemiparesis (13 girls and 12 boys) participated in this study, their ages ranged from 7 to 9 years; both the affected and unaffected sides were used in the study.
The following were used for evaluation:

- A universal goniometer (BASELINE) model (G 100) was used to measure the carrying angle.
- A hand held dynamometer was used for the evaluation of hand grip strength (meter indicator).
- At first, an initial screening was done which included the following:

Carrying Angle

- Identify the bony land mark, these include the acromion process, arm axis, medial epicondyle of the humerus, lateral epicondyle of the humerus, forearm axis, and radial styloid and ulnar styloid processes.
- Identify the center of the elbow joint between the medial and lateral epicondyle.
- The anatomic forearm axis was located between the middle of the elbow and the middle of the wrist. The carrying angle was measured from the arm and forearm axes.
- Child positioned in shoulder abduction, with an extension of the elbow, the forearm in supination, and the wrist neutral.
- Using a universal goniometer with a fixed arm positioned parallel to the middle of the arm and the movable arm of the goniometry is in line withthe supinated forearm.
- Hand Grip Measurement:
- First, the child was placed in a comfortable seated position with one arm held in 90degree flexion with the elbow adducted and the shoulder and forearm in a middle position.
- Second, the forearm was stabilized in a middle position with a strap in order to prevent movement.
- Then, the handheld dynamometer was placed in the child's hand so that the child would grip its handle.
- The child was asked to squeeze the handle of the dynamometer as hard as he/she could; this was repeated three times and the average measurement were calculated.
- Readings were recorded for both the carrying angle and hand grip measurements in order to carry out the statistical analysis.

RESULTS

All statistical measurements were performed using the Statistical Package for Social Science (SPSS) version 20 for Windows .As a prerequisite for parametric assumption, data was screened for normality. Normality assumption was assessed using tests of normality in addition to assessing the presence of extreme scores, skewness, and kurtosis. A descriptive analysis using histograms with a normal distribution curve showed that the data were normally distributed and did not violate the parametric assumption for each handgrip strength and carrying angle measurement. The box and whiskers plots of each of the tested variables showed that there were no outliers or extreme scores. All these findings allowed the researchers to conduct a parametric analysis. Consequently, the association between handgrip strength and carrying angle was made by using the Pearson product-moment correlation coefficient in order to determine whether there was any significant relation. The level of significance was ($P<0.05$).

Table 1. Bivariate correlations between handgrip strength and carrying angle in children with hemiparetic CP

	Carrying angle
Handgrip strength	r =-0.406 p=0.006*

Significant at alpha level 0.05.

Correlation between handgrip strength and carrying angle in children with hemiparetic CP

As presented in (Table4) and illustrated in Figure1, the correlation between handgrip strength and carrying angle in children with hemiparetic CP was studied through the Pearson product-moment correlation coefficient.

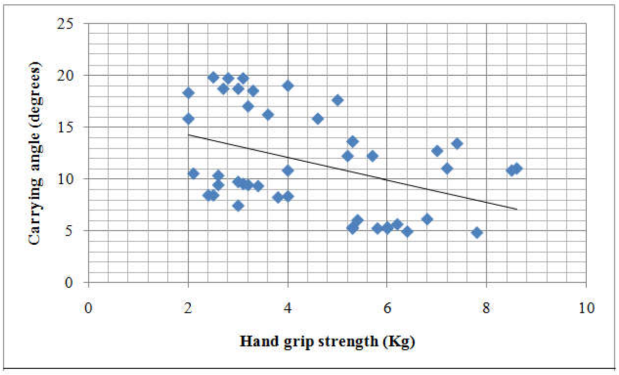

Figure 1. Scatter plot for the bivariate correlation between handgrip strength and carrying angle in children with hemiparetic CP

It revealed that there was a negative weak significant correlation (r=-0.406, p= 0.006*), meaning that handgrip strength decreases when the carrying angle increases.

DISCUSSION

The primary objective of this study was to determine the relationship between the carrying angle of the elbow joint and the hand grip strength of cerebral palsied hemiparetic children. The study was performed on 25, hemiparetic children aged between 7 and 9 years old, using a universal goniometer and analogue hand grip dynamometer .To understand the correlation between carrying angle and muscle strength, we used the subjects' unaffected sides as reference values for the obtained data. A comparison of the grasping results and the carrying angles in hemiparetic children revealed as statistically significant correlation. This correlation can be explained by the fact that children with hemiplegia suffer from neurological deficits that interfere with motor function. These impairments include neuromuscular and musculoskeletal problems such as spasticity, defective motor control, and muscle weakness that are apparent by the way that the hemiparetic hand grasps objects with an exaggerated motion throughout the entire movement and by the absence of anticipatory grasp formation. Poor grasping may also be due to poor visual motor integration between the sensory input coming from the afferent neurons and the motor output creating the power grip; it can also be affected by a decreased range of motion caused by muscle weakness that results from the upper motor neuron lesion.

The children's carrying angles become obvious with the elbow extensions and forearm supinations that were used as positions for measurement. Evidently, when the elbow extension increases, the carrying angle increases, and when the elbow flexion increases, the carrying angle decreases. In the current study, there was a significant increase in the carrying angle in the unaffected side; this may have been because of muscle weakness and decreased range of motion in the affected side which made the carrying angle less obvious. Our results disagree with Van Roy (2005) who showed that as the elbow is flexed, the carrying angle decreases. In our study, there was a positive correlation between the carrying angle and muscle strength measured by hand grip in the affected and unaffected sides, which means that when elbow flexion increases, the carrying angle also increases.

Poor performance may be attributed to impairment in the regulation of forces for power grip, according to force scaling which demonstrates that if the grip is too tight, an object cannot be manipulated, and if too loose, the object will be dropped. This aligns with a study (Lepage *et al*., 1998) that reported that palsied children may show a delay in the acquisition of various motor functions, such as fine motor skills, due to spasticity and motor weakness that consequently interfere with hand grip functions. Another study (Shumway and Woollacott, 2001) examined the reach and grasp behavior of developmentally disabled children, including those with hemiplegia. It revealed that a hemiplegic hand opens increasingly throughout the entire range of motion and that there is very slight closure of the hand after making contact with an object, resulting in a very clumsy grasp. As for correlation, the results of this study demonstrated that there is a positive significant correlation between carrying angle and muscle strength. Moreover, this result is in agreement with the findings of Ahmed Saeed, (Ahmed, 2013) who stated that there was significant correlation between muscle strength (measured in kilograms) and the cubitus valgus deformity of the elbow joint. Moreover, the first cross-sectional study of range of motion and carrying angle in 600 elbows of 300 participants taken from a pediatric population found that elbow joint range of motion and carrying angle increase with age and that carrying angle increases more in girls than it does in boys (Golden *et al*., 2007)

Conclusion

Hand grip muscle strength was reduced and directly affected by the carrying angle in both the affected and unaffected upper arms.The valgus position had positive correlation with hand grip, meaning that a hemiparetic hand grasps all objects with an exaggerated opening throughout the entire movement without an anticipatory grasp formation which later the hand grip will be directly affected by the degree of cubitus valgus angulation.

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