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THE EFFECT OF THERAPEUTIC TAPING ON HAND FUNCTION IN HEMIPLEGIC CEREBRAL PALSY CHILDREN

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ABSTRACT

Purpose: Hand disability is a characteristic problem in hemiplegic cerebral palsy children which leads to limitation in performance of their daily living and play activities. The aim of this work is to study the effect of kinesio taping (KT) on improvement of hand function in children with hemiplegic cerebral palsy.

Design: Experimental study (randomized controlled trial).

Subjects: Thirty hemiplegic cerebral palsy children (8–12 years) were randomized to two equal groups, study group and control group.

Procedure: Measurements of both total score for quality of upper extremity skill test (QUEST) and wrist extension range of motion (ROM) were applied for both groups before and after 3 months of the treatment. Control group received traditional physical therapy program, while the study group received the same program in addition to KT.

Results: Both total QUEST score and wrist ROM were significantly improved in both control and study groups in favor of the study group ($P < 0.05$).

Conclusion: KT is a good therapeutic adjunctive therapy for hand function in children with hemiplegic cerebral palsy.

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INTRODUCTION

Children with hemiplegia have unilateral involvement of upper and lower extremities opposite to the side of cerebral injury (Charles and Gordon, 2005). Children with hemiplegic cerebral palsy often have marked hand involvement with secondary musculoskeletal effects of the neurological insult such as muscle weakness or imbalance, limited active and passive range of motion, and poor functional activities at home and at school (Armer *et al.*, 2008). They may have abnormal hand postures such as thumb adduction and/or flexion with limited wrist extension, as well as more proximal abnormalities of upper limb tone, posture, and function, which also impact on hand use (Shepherd *et al.*, 2011). KT is a relatively new technique used in rehabilitation programs to strengthen weakened muscles, control joint instability, assist with postural alignment, and relax an over-used muscle (Yasukawa *et al.*, 2001). The KT is elastic enough to conform to the body, allowing for movement. The tape is latex-free, very thin, and stretches in the longitudinal plane.

Taping provides immediate sensor motor feedback regarding functional abilities. Sensory feedback and proprioception have a chief role in the development of proper motor schemas.

When functional taping was applied on the ankle of children with HCP, it showed an improvement in the functional performance of their ankles (Iosa *et al.*, 2010). In other studies, KT was applied with the aim of decreasing spasticity by enhancing the sensory inputs. The authors suggested that the application of KT might enhance skin receptor output, stimulating supraspinal centers, and thus improves joint position and kinesthetic senses and proper development of the motor control (Kara *et al.*, 2014; Tamburella *et al.*, 2014).

Good results of KT application are based on certain variables which include the amount of pre-stretch applied to the tape, position of the area to be taped, treatment goals (improved muscle function, pain reduction, improvement of subcutaneous blood flow) (Kase *et al.*, 2003).

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The aim of this research work was to study the effect of KT on the hand function in hemiplegic cerebral palsy children engaged in a rehabilitation program.

MATERIALS AND METHODS

1-Subjects

This study was conducted under the guidelines and the approval of Ethics Review Committee of the Faculty of Physical Therapy, Cairo University and parents signed a consent form authorizing the child's participation. Thirty hemiplegic children participated in this study which was held in the out-patient clinic of The Faculty of Physical Therapy, Cairo University. Children who met the following inclusion criteria were enrolled in the study; their ages ranged from 5 to 8 years, they were able to follow and accept verbal instructions, who with decreased muscle strength of the upper extremity as measured by manual muscle testing (poor to fair range) and/or abnormal muscle tone interfering with functional movement as measured by the Modified Ashworth Scale (MAS) (Bohannon and Smith, 1986).

The exclusion criteria were

- 1- All children were not participating in any rehabilitation program,
- 2- Any orthopedic surgery or botulinum toxin injection in the past 6 months,
- 3- Children with significant spasticity on the MAS of 3 or 4 (3 with considerable increase in tone, difficult passive movement and 4 with the affected parts rigid in flexion or extension),
- 4- Fixed contractures of upper limb, and
- 5- Children with allergic reactions to the adhesive compound of KT.

Children were randomly assigned into two groups of equal number control group and study group. Both groups received traditional physical therapy exercise program, with KT applied only to the study group.

2-Measures

The children were all evaluated by the same therapist to eliminate the variability found in manual muscle testing. Evaluation was conducted for each child of the two groups before and after three months of treatment. Instructions about the purpose and methods of testing were provided to make every child familiar with the device.

1-Quality of Upper Extremity Skills Test (QUEST)

The QUEST was applied to check the quality of upper limb skills. It comprises 33 items related to quality of movement in four domains that are essential components of normal developmental patterns between birth and 18 months (dissociated movements, grasp, weight bearing, and protective extension) (DeMatteo *et al.*, 1992). In this study, the primary outcome measure was two domains of the QUEST (dissociated movement and grasp). For each domain, a percentage score is calculated and the scores of the two domains can be summed to a total percentage score. According to the instruction manual, the total QUEST score and the scores of the domains are based on the summation of the hemiplegic and the non-hemiplegic side.

2- ROM test: The range of wrist extension was determined using digital goniometer (*Baseline*® *Digital Absolute+Axis*™ *Goniometer*). The goniometer provides an immediate digital display of single-plane angles ranging from 0-180 degrees on LCD screen.

3-Procedures

Control group

Children of this group received the traditional physical therapy program for hemiplegic cerebral palsy in the form of exercises to facilitate hand function (reaching, grasping, carrying and release and bilateral hand use), neurodevelopmental technique, proprioceptive training, facilitation of righting and equilibrium reactions, stretching exercise for the muscles liable to be tight, strengthening exercises for the antispastic muscles, and facilitation of gait training (open and closed environments).

Study group

Children of the group received the previous physical therapy program in addition to KT. Wrist joint alignment was corrected towards extension for all the children and then KT was applied at the dorsum of hand and wrist and forearm, extending from metacarpophalangeal joints to cover the wrist extensor muscles distally. KT was worn continually for 3-5 days and left off for 1-2 days to allow the skin to breathe. Because the tape is water resistant, the child could bathe or swim with it. Parents were instructed in tape removal and application as appropriate (Grandi *et al.*, 2012).

4-Data Analysis

The study data were analyzed using the SPSS statistical package (version 16). Independent-samples t tests and paired t tests were applied to compare between the pre and post-treatment results in both groups and within groups, respectively. Prior to data analysis, the level of significance was set at $P < 0.05$

RESULTS

Thirty children with hemiplegic cerebral palsy participated in this study and they were classified into study and control groups. Each group included 15 children with mean age \pm SD (6.2 ± 0.87) years of both sexes. There was no statistically significant difference between the mean values of age, and muscle tone of both groups ($p > 0.05$).

Comparisons of pre-treatment values revealed no statistically significant difference between the study and control groups regarding QUEST and ROM variables.

Comparing pre and post treatment values of total QUEST scores in the control and the study groups, significant differences were found ($p = 0.008$) and ($p = 0.000$) respectively. Also, comparing the pre and post treatment values for both groups in terms of wrist extension ROM, significant differences were in the control group ($p = 0.043$) and in the study group ($p = 0.000$) (Table I). In post treatment comparison between the two groups, significant improvement was reported

in terms of upper extremity skills and ROM in both groups favoring the study group ($p < 0.05$) (Table I).

Table 1. Mean values (mean \pm SD) of total QUEST score and wrist extension (degree)

Measure	Pre		Post		P
	Control	Study	Control	Study	
QUEST total	34.3 \pm 2.8	33.1 \pm 2.6	37.1 \pm 2.6	46.4 \pm 3.6	0.005
wrist extension ROM	35.55 $^{\circ}$ \pm 5.524	35.5 $^{\circ}$ \pm 4.971	39.7 $^{\circ}$ \pm 5.219	45.4 $^{\circ}$ \pm 4.913	0.000

DISCUSSION

This study aimed to investigate the therapeutic effect of KT on functional performance of hand in hemiplegic cerebral palsy children. The results showed a great improvement of hand function and wrist ROM when KT was applied. This is probably due to breakdown of the pathological motor schemes and acquisition of more correct ones, allowing the emergence of accurate movements (Mazzone *et al.*, 2011). Taping for the dorsum of wrist and forearm could lead to increased firing of cutaneous afferents on the underlying skin during wrist flexion. This could lead to enhanced proprioceptive feedback (Edin, 2004). Complicated interactions at spinal cord level lead to integration of signals from the different proprioceptive afferents (Mazzone *et al.*, 2011), which can affect muscle spindle sensitivity through modulation of gamma motor neuron firing, and perhaps alter the balance of muscle activity to strengthen wrist extensors over time (Gomez-Soriano *et al.*, 2014).

The results of this study comes in agreement with Iosa *et al.* (Iosa *et al.*, 2010) who revealed a greater increment in gross motor function measure scores (GMFMS) as well as improved gait after application of taping at the ankle joint in children with unilateral spastic CP. Also, Simsek *et al.* (2011) achieved improvement in sitting posture in children with CP when paraspinal muscles were taped for 3 months. Again, significant improvements in upper extremity functions were seen both immediately and after 3 days of KT for children with acute rehabilitation setting (Yasukawa *et al.*, 2001) and in adults following stroke (Jaraczewska and Long, 2006). On the opposite side, GMFM scores were not significantly improved when measured by Footer (2006) after KT application on paraspinal muscles in tetraplegic cerebral palsy children for 3 months, twice a week.

CONCLUSION

In conclusion, KT was effective and promising in improvement of hand function in hemiplegic cerebral palsy children. Further studies should be applied to investigate if KT results will be maintained over time without any further changes.

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DECLARATION OF INTEREST

The author reports no conflict of interest. The author alone is responsible for the content and writing of this paper.

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