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ROLE OF NEUROMUSCULAR TAPING ON STANDING AND WALKING ABILITIES IN CHILDREN WITH DIPLEGIC CEREBRAL PALSY

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ABSTRACT

Aim: The aim of this study was to study the effects of neuromuscular kinesiotaping (NMKT) on standing and walking abilities in children with spasticdiplegic cerebral palsy (CP).
Methods: This study was designed as randomized controlled trial. Thirty CP children of spastic diplegic type were randomized and equally divided between the study group (group I) who received NMKT and the traditional physical therapy program and the control group (group II) who received only the traditional physical therapy program. All children were evaluated by the Bio dexstability system for the total stability index (SI), anterposterior (A/P) SI, mediolateral (M/L) SI, and by the Gross Motor Function Measure (GMFM) (D) for standing and (E) for walking, jumping, and running before and after 3 months of treatment.
Results: By comparison of the pre and post treatment results, a significant improvement has been achieved in both groups for all the measured variables (total SI, A/P SI, M/L SI, GMFM (D) except in GMFM (E) in group II, ($p<0.05$). Also significant differences have been found when comparing the post treatment results between the two groups in all of the measured variables (total SI, A/P SI, M/L SI, GMFM (D) and in GMFM (E) in favor of the group I ($p<0.05$)
Conclusion: NMKT is a promising additional approach to improve the standing and walking abilities and balance via cutaneous and proprioceptive feedback in CP children of spastic diplegic type.

INTRODUCTION

Cerebral palsy (CP) is defined as a group of disorders in the development of movement and posture that cause limitations in daily activity (Rosenbaum *et al*., 2007). Diplegia is a form of CP in which the lower extremities are more affected than the upper ones manifested by difficulties in standing and walking and balance (Erkin *et al*., 2008). The previous researches revealed that CP children, in general, have a lower postural balance ability compared with typically developing children of similar developmental levels (Cherng *et al*., 2009; Donker *et al*., 2008). Standing postural balance control is important for gait, handling abilities and in helping the child to recover from unexpected balance disturbances (Woollacott and Shumway-Cook, 2005). Diplegic CP children showed, on moveable forceplate, lower displacement velocities than normal children of the same age, and they take a longer time to recover their stability level (Shumway-Cook *et al*., 2003).

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The characteristics of the neuromuscular system contributing to the balance constraints include the croushed posture in spastic diplegia, a delayed onset of muscle contractions, a disorganized timing of muscle responses with the proximal muscles are activated before the distal muscles (i.e: activation of quadriceps and hamstrings before activation of gastrocnemius and tibialis anterior), and an increased co-contraction of antagonist muscles with agonists with loss of selectivity in neuromuscular output.

Such changes will cause low and slow recovery of balance (Roncesvalles *et al.,* 2002). Most of gait constraints in neurological disorders are caused by ankle spasticity, joint mal- alignment in lower extremities and the decrease of balance (Scivoletto *et al*., 2008; Tamburella *et al*., 2013), which are all positively affected by NMKT (Cortesi *et al*., 2011). Recently, the NMKT has been proposed as a beneficial tool that could be used in physical rehabilitation. It is a specialized tape which is thin and elastic fibers and that can be stretched over the skin. It allows a partial to full range of motion for the applied joints and muscles with different pulling forces to the skin (Scivoletto *et al*., 2008). NMKT has

been documented to enhance somatosensory inputs by increasing the cutaneous stimuli (Halseth, 2004). It is reported that NMKT could generally improve the muscle tone, range of motion and balance parameters. According to the treatment goals, and the application technique, NMKT can be used either to facilitate a weakened muscle or to relax an over-contracted muscle (Lin *et al*., 2011). The aim of the current study was to investigate the effects of NMKT on balance and on standing and walking abilities in children with spastic diplegic cerebral palsy.

MATERIALS AND METHODS

Subjects

Forty cerebral palsy children of spastic diplegic type were included in this study. Their ages were ranging from 7 to 10 (mean age 8±2.3) years old. Before evaluation, parents signed an informed consent to include their children in the study which had been approved by the Ethics Committee of Faculty of Physical Therapy Cairo University, Egypt and in accordance with the code of ethics of the world medical association (Declaration of Helsinki) for experiments involving humans. Children who are able to stand independently for at least 30 seconds and who had standing balance problems were included in this study. Balance was confirmed by using the tilt board balance test with both eye opened and closed in the four directions (anterior, posterior, and lateral tilt).

All children were with sufficient cognition to understand commands given to them. They were excluded if they had fixed deformities or losses of hearing and vision which can interfere with their participation Children who received Botox for last 6 months. Children were classified randomly into two groups of equal number study group (group I) received NMKT in addition to the traditional physical therapy program to facilitate postural control and balance and control group (group II) received only the same traditional physical therapy program, in addition the two groups received exercises therapy program to facilitate postural control and balance.

Methods

Evaluation parameters: Each child of both groups was evaluated by the following parameters before and after 3 months of treatment. A preliminary session was applied prior to evaluation procedures in order to make the child familiar with test steps

Biodex stability system: standing balance was evaluated by Biodex system for each child of both groups. The child was asked to stand with two legs stance on the center of the platform while grasping the handrails, the display screen was adjusted so that each child can look straight at it. Then the child was asked to achieve a centered position by shifting his/her feet position until it was easy to keep the cursor (representing the center of the platform) centered on the screen grid while standing in an upright position. Once the cursor became in the center of the display target, he/ she was asked to maintain his/her feet position till the platform was stabilized, hence, heels coordinates and feet angles from the platform were recorded and provided to the computer. The platform was advanced to an unstable state and then the child was ordered to focus on the visual feedback screen with both his/her arms beside in an attempt to maintain the cursor in the middle of the bulls eye on the screen, then the mean of three repetitions was obtained.

GMFM: It is a standardized observational instrument designed to measure change in gross motor function over time in children with cerebral palsy. The GMFM tests activities in 5 dimensions: (A) lying and rolling, (B) sitting, (C) crawling and kneeling, (D) standing, and (E) walking, running and jumping. In this work, it was applied to assess dimension (D) and (E).

Treatment procedures

All children in both groups received physical therapy treatment program for one hour, 3times weekly and for 3 successive months. It was in the form of balance and postural control exercises as following:

- Stretching for shortened muscles (hip flexors, hip adductors, knee flexors, and ankle plantar- flexors).
- From standing with manual knee lock, lateral shift of body weight on each side and anteroposterior, oneleg standing, stoops and recovery.
- Facilitation of righting, equilibrium and protective reactions from standing.
- Facilitation of walking forward, backward, and sideways (closed and open environments).
- Neurodevelopmental technique, proprioceptive training, strengthening exercises for the anti spastic muscles.

For group (I): NMKT was applied bilaterally to the calf muscles with a Y-shaped strip while the child was in prone position, with the kneeextended and theanklein90◦ passive dorsiflexion. NMKT application was directly to the skin from the calcaneus to them edial and lateral femoral condyles. It is prescribed for application twice a week, every days with on day rest, to avoid allergic reactions.

Statistical Analysis: the mean values of stability indices, (total SI, A/P SI, and M/L SI), and of GMFM were obtained before and after three months in both groups and they were compared using paired "t" test. In depend ent "t" test was used for the comparison between the two groups ($P<0.05$).

RESULTS

As revealed in Table (1), the raw data (mean ± SD) of both groups representing the total SI, A/P SI, M/L SI, GMFM (D) for standing, and GMFM (E) for walking, running, and jumping were all collected before and after three months of treatment and they were all statistically analyzed. The gained results in this study revealed no significant differences when comparing the pretreatment mean values of both groups. Comparing their pre and post- treatment mean values, significant improvements were found in all of the measuring variables of both groups I and II except for GMFM (E) in group II as it was not significantly improved. After treatment, significant differences were observed when comparing the post-treatment results of the two groups in favor of group II.

Table 1. Before and after treatment mean values (mean± SD) of groups I and II

Parameters	Group I		P- value	Group II		P- value	Comparison of post treatment values
	Before	After		Before	After		(p- value)
Total SI	1.432± 0.142	0.981±0.081	0.0001	1.453±0.157	1.102± 0.043	0.0001	0.0001
A/P SI	1.323±0.091	0.846±0.034	0.0001	1.401±0.180	0.952±0.025	0.0001	0.0001
M/L SI	1.062±0.106	0.675±0.211	0.0001	1.105±0.082	0.861±0.0651	0.0001	0.0026
GMFM(D)	94.38±2.812	98.15±3.214	0.001	93.41±1.901	95.83±1.809	0.001	0.0215
GMFM (E)	95.78±2.201	99.33±2.572	0.0004	96.34±1.604	97.11±3.042	0.393	0.03

SD: Standard deviation, P- value: Level of significance, SI: stability index, A/P: Anteroposterior, M/L: Mediolateral, GMFM: Growth motor function measure.

DISCUSSION

Little literature proved the effects of NMKT in neurological lesions. In this study, effects of NMKT on balance and on standing and walking abilities were examined in children with diplegic cerebral palsy for three successive months. The post treatment results showed significant improvement of all the measuring variables related to stability indices (total SI, A/P SI, and M/L SI) and GMFM (D and E) concerning standing and walking abilities in group I in favor of group II. The alterations in the balance control system might be explained by changes in skin receptor inputs due to application of NMKT. The mechanical effects of applying tape to the skin might increase skin receptor output, stimulating supraspinal centers and thus enhancing kinesthetic and joint position sense and improving balance (Halseth, 2004).

The possible neuromuscular response to application of NMKT may include (1) improved proprioception in leg muscles through cutaneous mechanoreceptors in the taping area, (2) enhanced synaptic efficacy within primary sensor motor cortex pathways, (3) higher level adaptations at the level of cerebellum or association cortex, and (4) good contraction timing between agonist and antagonists (Yoshida and Kahanov, 2007; Lemay and Nadeau, 2010). These positive effects could improve gross motor capacity and independent functions in daily living activities (Halseth, 2004). Another explanation to the obtained positive results may be that NMKT could correct the joint mal-alignment in conjunction with the motor intervention techniques applied to facilitate muscle contractions.

The results of the current study came in agreement with the authors (10,14) who observed positive effect sofkinesiotaping of the ankle on center of pressure balance parameters, suggesting that an kletaping helps stabilize body posture immediately in multiple sclerosis and stroke patients. Also, Kilbreath *et al*. (2006) suggested improvement in hip extension during gait when NMKT was applied on gluteus muscles through cutaneous stimulation. In another study, although significant differences were observed in range of motion, clonus, balance, and 6 minutes walking test after 48 h of NMKT, but these changes declined after 48 h due to the chronic condition (Arazpour *et al*., 2013). Tamburella *et al*., 2013 also proved specific improvement in gait in subjects with incomplete Spinal cord injury. The 3 months of NMKT application, twice a week with one day rest in between, was supported by the authors (Herrington and Payton, 1997; Paige, 2006)who stated that NMKT allows the individual to gain better therapeutic benefits with the tape application and removal for successive twelve weeks. In a certain study, results revealed no positive effects were obtained by combining ankle NMKT and botulinumtox into reduce plantar flexor spasticity, although enhancement of stride length, gait velocity, and movement amplitude were achieved (Karadag-Saygi *et al*., 2010). Although a few studies to investigate the effect of NMKT on gross motor functions, some studies achieved significant improvement in sitting posture and functional independence with application of NMKT because of increased trunk stability and better postural alignment (Simsek *et al*., 2011; Yoshida and Kahanov, 2007). In contrast, only one study, according to the review of literature, that investigated the effect of NMKT on gross motor functions, with no significant improvement in postural control in the sitting position when evaluated by the GMFM-88 in quadriplegic cerebral palsy children (Footer, 2006).

Conclusion

Clinically, the results of this study could help physiotherapists to enhance their rehabilitation program via using NMKT as an adjunctive therapy tool in improvement of balance and standing and walking abilities in children with cerebral palsy of diplegic type.

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Conflict of Interest

There are no conflicts of interest or financial disclosures of any author of this manuscript. None of the authors have any financial interest.

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REFERENCES

Arazpour, M., Bani, M., Hutchins, W., Curran, S. and Javanshir, M. 2013. The influence of ankle joint mobility when using an orthosis on stability in patients with spinal cord injury: a pilot study. *Spinal Cord,* 51, 750–754.

Cherng, R., Lin, H. and Ju, H. *et al*. 2009. Effect of seat surface inclination on postural stability and forward reaching efficiency in children with spastic cerebral palsy. *Res Dev Disabil*., 30(6):1420–1427.

Cortesi, M., Cattaneo, D. and Jonsdottir, J. 2011. Effect of kinesiotaping on standing balance in subjects with multiple sclerosis: a pilot study. *Neuro Rehabilitation,* 28, 365–372.

Donker, S., Ledebt, A. and Roerdink, M. *et al*. 2008. Children with cerebral palsy exhibit greater and more regular postural sway than typically developing children. *Exp Brain Res.,* 184(3):363–370.

Erkin, G., Delialioglu, S. and Ozel, S. *et al*. 2008. Risk factors and clinical profiles in Turkish children with cerebral palsy: analysis of 625 cases. *Int. J. Rehabil Res.,* 31(1):89–91.

Footer, C.B. 2006. The effects of therapeutic taping on gross motor function in children with cerebral palsy. PediatrPhysTher, 18: 245–52.

Halseth, T. and WMJDML: 2004. The effects of kinesio TM taping on proprioception at the ankle. *J. Sports Sci. Med.,* 3, 1–7.

Herrington, L. and Payton, C. 1997. Effects of corrective taping of the patella on patients with patellofemoral pain. *Physiotherapy,* 83: 566-572.

Karadag-Saygi, E., Cubukcu-Aydoseli, K., Kablan, N. and Ofluoglu, D. 2010. The role of Kinesio Taping combined with botulinum toxin to reduce plantar flexors spasticity after stroke. Top. *Stroke Rehabil,* 17, 318–322.

Kilbreath, S., Perkins, S., Crosbie, J. and Mc Connell, J. 2006. Gluteal taping improves hip extension during stance phase of walking following stroke. *Aust. J. Physiother*, 52, 53–56.

Lemay, F. and Nadeau, S. 2010. Standing balance assessment in ASIAD paraplegic and tetraplegic participants: concurrent validity of the Berg Balance Scale. Spinal Cord, 48, 245–250.

Lin, J., Hung, C. and Yang, P. 2011. The effects of scapular taping on electromyographic muscle activity and proprioception feedback in healthy shoulders. *J. Orthop. Res.,* 29, 53–57.

Paige, C. 2006. Iinitial effects of anti-pronation taping on medial longitudinal arch during walking and running. *Br. J. Sports Med.,* 39(12): 939.

Roncesvalles, N., Woollacott, M. and Burtner, P. 2002. Neural factors underlying reduced postural adaptability in children with cerebral palsy: *Neuroreport,* 13: 2407-2410.

Rosenbaum, P., Paneth, N., Leviton, A., *et al*. 2007. A report: the definition and classification of cerebral palsy. *Dev Med Child Neurol Suppl*, 109:8–14.

Scivoletto, G., Romanelli, A., Mariotti, A., Marinucci, D., Tamburella, F. and Mammone, A. *et al*. 2008. Clinical factors that affect walking level and performance in chronic spinal cord lesion patients. *Spine,* 33, 259–264.

Shumway-Cook, A., Hutchinson, S. and Kartin, D. *et al*. 2003. Effect of balance training on recovery of stability in children with cerebral palsy. *Dev Med Child Neurol.,* 45(9):591–602.

Simsek, T., Turkucuoglu, B., Cokal. N., Ustunbas, G. and Simsek, I. 2011. The effects of Kinesio(R) taping on sitting posture, functional independence and gross motor function in children with cerebral palsy. Disabil Rehabil, 33: 2058–63.

Tamburella, F., Scivoletto, G. and Molinari, M. 2013. Balance training improves static stability and gait in chronic in complete spinal cord injury subjects: a pilot study. Eur. J. Phys. Rehabil. *Med.,* 49, 353–364.

Woollacott, M. and Shumway-Cook, A. 2005. Postural dysfunction during standing and walking in children with cerebral palsy: what are the underlying problems and what new therapies might improve balance? Neural Plast., 12(2-3):211–219.

Yoshida, A. and Kahanov, L. 2007. The effect of kinesio taping on lower trunk range of motions. *Res Sports Med.,* 15: 103–12

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