



Muscle Inhibitory Vs Functional Corrective Kinesio Taping on Gross Motor Functional Abilities in Children with Spastic Cerebral Palsy

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Authors' contributions

This work was carried out in collaboration between all authors. Author ANK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors FHA and KAO managed the analyses of the study. Authors ERAR and ORA managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JOCAMR/2018/42637

Editor(s):

(1) Dr. Arun Singh, Professor, Community Medicine, Rohilkhand Medical College & Hospital, Bareilly International University, India.

Reviewers:

(1) Timothy Hui, Orthopaedic Medicine and Surgery, USA.

(2) Alessandro da Silva Oliveira, Augusto Motta University Center, Brazil.

Complete Peer review History: <http://www.sciencedomain.org/review-history/25427>

Original Research Article

**Received 13th April 2018
Accepted 30th June 2018
Published 6th July 2018**

ABSTRACT

Background and Purpose: Spastic cerebral palsy affects ankle joint function leading to a decrease of the gross motor functional abilities. The purpose of the study was to compare the Muscle inhibitory with Functional corrective Kinesio Taping applications on gross motor functional abilities of children with spastic cerebral palsy.

Methods: Thirty-two children with spastic cerebral palsy were selected from the outpatient clinic of the faculty of Physical Therapy Cairo University. Muscle inhibitory and functional corrective Kinesio

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taping applications in addition to physical therapy program were applied for three successive months. Peabody Developmental Motor Scales was used to assess the gross motor functional abilities.

Results: The study revealed that statistically and clinically there was no difference between both applications.

Conclusion: Muscle inhibitory and Functional Corrective Kinesio Taping applications both can be used for increasing the gross motor functional abilities of children with spastic cerebral palsy with no favour to any of them.

Keywords: Kinesio tape; gross motor functional abilities; spasticity; children; cerebral palsy.

1. INTRODUCTION

Cerebral Palsy (CP) is a non-progressive lesion in the infant brain that affects movements and posture leading to activity and functional limitations [1-3] where movement and postural disorders are the main symptoms of CP. CP has been traditionally classified by the type of movement disorder and anatomical distribution. Movement patterns include spastic, dyskinetic, hypotonic, ataxic, and mixed forms of CP [4].

Spastic CP is the most common type; its main feature is spasticity which is hyper-tonia and hyper-reflexia in the muscle [5,6].

Spasticity is a complex motor disorder that arises from central nervous system dysfunction, causing changes to all locomotor systems and affecting the gross motor functional abilities of children with spastic CP [7,8]. Spasticity causes many motor abnormalities such as a decrease in the range of motion (ROM), feeling stiffness, delayed in the gross motor milestones, difficulty in movement, muscular tightness or contracture and many other disorders such as equinovarus foot [9].

Kenso Kase introduced Kinesio tape (KT) in the late 70's [10]. KT has been proved to increase muscle function, increase lymphatic drainage, and improve blood flow, decrease pain, increase proprioception and correct joint alignment [11,12]. KT is used over the last few years to increase the functional abilities of children with CP [13].

Concerning the physiological Effect of KT, It's suggested that the cutaneous afferent stimulation and motor unit firing in both central and peripheral nervous systems plays an important role. It was shown that peripheral nerve stimulation promotes excitability to the motor cortex [14]. The muscular functional performance

may be improved due to the inducement of cutaneous stimulation which efficiently recruits the motor units [15]. Muscular inhibition is thought to be achieved by Golgi tendon organ stretching in the distal ends of the muscles. KT has been proved to be effective in pain control by muscle activity inhibition [16].

It's stated that the KT muscle taping can change muscle tone as it refers to the tension that is maintained by central nervous system impulses as long with periphery afferents from the skin, muscles or even proprioceptors from joints through the peripheral feedback system. Skin receptors are activated by KT application, through enhancement of the afferent signals from the periphery. This mechanism can be used to influence tonus regulation; also KT is thought to assist muscle control through exciting the mechanoreceptors and proprioceptors that control postural motor function and dynamic functions of joints [17].

There are different KT applications, such as muscle inhibitory, functional corrective, mechanical corrective...etc. Muscle Inhibitory KT inhibits muscle tone through Golgi tendon organ stretching at the muscle's distal ends [16]. The functional Corrective KT improves joint ROM through stimulating joint proprioceptors [18].

A lot of researches discussed the KT effects on many variables in children with spastic CP, but as far as we know no study aimed to compare between the effects of muscle inhibitory KT with Functional KT applications. This study was designed to compare the Muscle inhibitory with the functional corrective KT applications to obtain which is more effective in improving gross motor functional abilities in children with CP. It was hypothesized that there is no difference between muscle inhibitory and functional corrective KT applications on gross motor functional abilities in children with spastic CP.

2. METHODS

2.1 Design

Our study design is a prospective, parallel, simple randomized clinical trial between two groups (from November 2016 till April 2017). Data were collected from the Outpatient's Clinic of the Faculty of Physical Therapy Cairo University. The Research Ethical Committee of the Faculty of Physical Therapy Cairo University approved the study protocol (Approval No.: P.T.REC/012/001323) and it was registered in the Pan African Clinical Trials Registry (PACTR) database (trial no. PACTR201702002019178). Informed consent was obtained from all participants' caregivers as stated in the Declaration of Helsinki.

2.2 Participants

Thirty-two children with spastic CP were selected from the Out-Patients Clinic of the Faculty of Physical Therapy, Cairo University. Children were included if they were at level II according to Gross Motor Function Classification System (GMFCS), their developmental age ranged from 9 to 12 months according to Peabody Developmental Motor Scales (PDMS). The children ranged from 2 to 4 years chronological

age and their degree of spasticity ranged from 1 to 1+ according to Modified Ashworth' Scale. They were excluded if they were hypersensitive to KT application, had fixed deformities in the ankle joint or had previous tenotomy operation to calf muscles. All children had no Botulinum Toxin in the last six months prior to the study and took no antispastic drugs during the study period.

2.3 Randomization

In Fig. 1, the CONSORT (Consolidated Standards of Reporting Trial) flow chart shows the number and distribution of the subjects. Forty-three subjects with spastic CP were assessed for trial eligibility. Three subjects were excluded as they were not fit the selection criteria. The rest forty subjects were divided via simple randomization (using coin tossing) into two groups.

Twenty subjects entered study group (A), where four subjects discontinued the treatment, and one had an allergic reaction from the tape despite he passed the sensitivity test. The other twenty subjects entered study group (B), where three subjects discontinued the application.

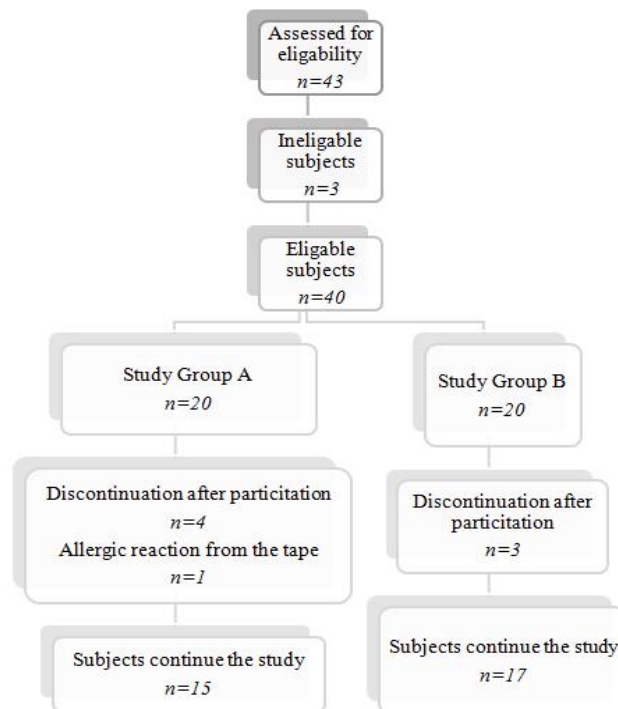


Fig. 1. Flow Chart of the study based on consolidated standards of reporting trials (CONSORT)

2.4 Materials

2.4.1 Materials for sample selection

Modified Ashworth scale was used to measure the degree of spasticity. The chosen children were graded 1 and 1+. Grade 1 is a slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion (ROM) when the affected part(s) is moved in flexion or extension, while Grade 1+ is a slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM.

GMFCS was used to select children who need minimal assistance holding on of functions such as standing and walking: Level II GMFCS. The selection of level II GMFCS children for KT application was supported by Rasti et al. [19]. For sensitivity test, we applied a small patch of KT (5 cm X 5 cm) on the child skin for 1 week, and then if any redness or itching appeared, the child was excluded from the trial.

The PDMS second edition was used to determine the developmental age of the children with cerebral palsy [20].

2.4.2 Materials for evaluation

PDMS – Second Edition was used to assess gross motor function motor development through the gross motor scale that PPMS-2 includes. For testing Procedures the materials were used to test each child was prepared, the room was free from disturbance; however, the parent or caregiver was allowed to remain during testing. Each child was encouraged to do his/her best performance. When the child was unable to perform a task quickly; we proceeded to the next item.

Scoring is based on score criteria which are described in details in each single item in the “record of item performance”, where it's scored as 0, 1, 2. If the patient scores 3 successive zeros (0), the subtest is stopped and to be move on to the next sub test.

We evaluated only the gross motor skills which are divided into 4 subtests which are Reflexes which consist of 8-item subtest measures a child's ability to automatically react to environmental events; Stationary which is 30-

item subtest measures a child's ability to sustain control of his or her body within its center of gravity and retain equilibrium; Locomotion (89-item subtest) measures a child's ability to move from one place to another and finally object Manipulation (24-item subtest) measures a child's ability to manipulate balls.

For total scoring all the scores of the items are added together forming a sub test raw scores, this raw was converted into standard scores, using the table scores converter in the Peabody examiner record booklet then finally the standard scores was converted via the same table converter to Gross Motor Quotient (GMQ).

2.4.3 Materials for intervention

Physical therapy tools was used for conducting the physical therapy program were Mat, Swiss ball, tumble form set (rolls, wedges, block), adjustable stairs, balance board, stairs, stand bar, stepper, balance beam; in addition to the materials used for ankle taping application: Elastic (Kinesio Tex® Tape(5.0 cm width X 5 m length) and a scissor.

2.5 Intervention

2.5.1 Designed physical therapy program for both groups

A physical therapy program was designed based on Neuro-Developmental treatment (NDT) approach with emphasis on exercises that encouraged independent standing, enhancement and facilitation of gait patterning. Stretches exercises, strengthening exercises, approximation, and ankle ROM exercises. The program was applied for one hour, three times per week for three successive months.

2.5.2 Preparation for both study groups

As a preparation, the skin area of tapping was cleaned- before applying the tape- by water then dried or by organic solvent (alcohol pad).

The KT in both applications was applied for six days and removed for 1 day as supported by Gómez-Soriano et al. to allow skin perspiration [21].

2.5.3 Muscle inhibitory kinesio tape application for Group A

One Y strap was prepared for each child individually. Maximum stretch of calf muscle was

applied, then the distance from tendonachllis and the crease of the knee was measured. The KT was cut according to the measure distance. The Y strap was applied from insertion to origin direction (tendonachllis to the origin of soles muscle and gastrocnemius) with a very small amount of stretch applied to the KT (15% of the initial tape length (Fig. 2).



Fig. 2. Muscle Inhibitory KT

2.5.4 Functional Corrective Kinesio Tape application for Group B

One I strap was prepared for each child individually (Fig. 3). The distance from tibial plateau along with dorsal aspect of the lower leg down to the ankle crease was measured for the preparation of the strap .We decreased the measured tape length by 1/3 (stretch for the tape) to provide joint reposition by taking the ankle to a dorsi-flexion.



Fig. 3. Functional corrective KT

2.6 Data Analysis and Statistical Design

Descriptive data of both groups concerning gender, spasticity distribution and developmental

age were collected. Graphpad Quickcalc software was used for statistical analysis. Data were statistically described in terms of means, standard deviation. Paired t-test was used to compare the results pre and post treatment in the same group; while unpaired test was used to compare the results between the two groups. Significant level was set at alpha level <0.05.

3. RESULTS

3.1 General Characteristics of the Subjects

Study Group (A) included fifteen children (3 girls and 12 boys) with spastic CP (5 bilateral, 7 left unilateral and 3 right unilateral) were included in this group. The mean developmental ages (in months) were 10.40 ± 1.29835 . Study Group (B) included seventeen children (8 girls and 9 boys) with spastic CP (10 Bilateral, 5 right unilateral and 2 left unilateral) were included in this group. The mean of developmental age (in months) were 10.47 ± 1.4194 . Comparing the general characteristics of the subjects of both groups revealed that there was no significance difference between them in the developmental mean age.

The spasticity distributions in lower limbs in study group (A) was 33.33% bilateral, 20% right unilateral and 46.67 % left unilateral, and study group (B) was 58.82% bilateral, 29.41% right unilateral and 11.76% left unilateral .

3.2 Results within Subjects

In study group (A) the mean and standard deviation of Gross Motor Quotient in PDMS that indicates the gross motor functional skills of the subjects, pre and post treatment for group (A) was statistically analyzed. There was an extremely statistically significant difference of Gross Motor Quotient between Pretreatment value and Post treatment value as t-value was (5.9450) and p-value was (0.0001). The percentage of improvement was 11%.

In study group (B) the mean and standard deviation of Gross Motor Quotient in PDMS that indicates the gross motor functional skills of the subjects, pre and post treatment for group (B) was statistically analyzed. There was a significant difference of Gross Motor Quotient between Pretreatment value and Post treatment value as t-value was (4.1303) and p-value was (0.0008).The percentage of improvement was 11.92%.

3.3 Results Comparison between the Two Study Groups

Comparing the mean values of Gross Motor Quotient in PDMS that indicates the gross motor functional skills of the subjects of the "Pretreatment" between study group (A) and study group (B), showed there was no significant differences between the 2 groups ($P = 0.1377$). Also, it was revealed that the mean values of the "Post treatment" between study group (A) and study group (B) showed there was no significant differences between the two groups where $P = 0.2082$ (Table 1 Fig. 4).

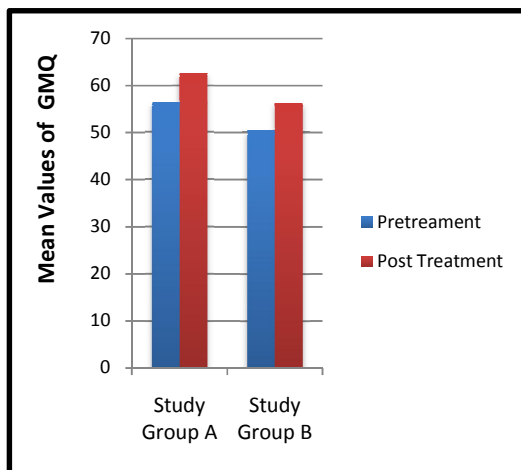


Fig. 4. Mean values of GMQ pretreatment and post treatment in both groups

4. DISCUSSION

The current study accepts the hypothesis where the muscle inhibitory and the functional corrective shows the same effect on improving gross motor function abilities in children with spastic CP.

The functional abilities of CP children declines as a result of exaggerated muscle tone [22], that why we chose children CP in our study.

The subjects were selected from 9 to 12 months Developmental age. We decided to use the developmental age besides the chronological age as it is a predictor of the child current and further abilities [23].

The current study rejected to select subjects according to the American academy of pediatrics classification. We agreed with previous

researchers who pushed to use new methods of classification of CP. A study introduced an idea to stop using the term of diplegia, as definitions differ from paper to another, so what you may consider diplegia other researcher may consider it as quadriplegia forming a non reliable method that shouldn't be used for research purposes [24]. Hurvitz and Brown stated that terms like quadriplegia, hemiplegia and diplegia should be abandoned in researches a reliable method of classification like GMFCS System should be used instead [25].

We chose for the selection criteria to use the Gross Motor Functional Classification for selection of children with cerebral palsy in level II in the system as it is widely used in research studies as a type of classification of cerebral palsy. The GMFCS have been validated and a reliable method to use [26], that also strongly agreed with other studies that confirm the high reliability and validity of the GMFCS and it have been recommended to use it on children with cerebral palsy [27].

PDMS was chosen for assessing the children's gross motor abilities and also to determine their developmental ages. This scale is known for its high accuracy and reliability [28], that was confirmed with a studies that revealed the high reliability and validity of PDMS Second Edition [29,30]. PDMS- Gross Motor (PDMS-GM) was preferred to be used in the assessment of gross motor abilities of children in clinical trials as it provide a global measure of changes in motor development of the child's [31].

Concerning the physical therapy program, a study confirmed that a rehabilitation program gives a benefit for CP children and help in their progress [32], that why the current study included physical therapy program in the rehabilitation plan.

In this study, we revealed that both functional corrective and muscular inhibitory improves the gross motor function in children with spastic CP, comparing the pre and post assessment results.

KT was proven to have a great impact in increasing the proprioceptive feedback and the gross motor functions in children with spastic cerebral palsy which result in enhancement of the daily living activities [33] that confirms this study results that shows increase in the gross motor quotient in the PDMS in children with spastic CP.

Table 1. Comparison of the mean values of GMQ pre and post treatment in both groups

Scoring	Pre treatment M ± SD	Post treatment M ± SD	P- value
Study Group A n=15	56.40±11.09	62.60±11.41	0.0001
Study Group B n=17	50.35±11.28	56.35±15.45	0.0008
P-value	0.1377	0.2082	

SD= Standard Deviation, P =Probability, M = Mean

Another study supported our results, as it mentioned that the KT application was very effective in improving gross motor skills in children with CP [34]. A pilot study also confirmed the fact that KT has a benefit in the enhancement of dynamic and functional activities in children with cerebral palsy [35].

Supporting this study results of KT impact on gross motor function, Öhman mentioned that KT accompanied with physical therapy program allow motor functional abilities in pediatrics population [36]. Ankle KT application was found to be improving gross motor function through improving the postural control and realigning of the ankle position as it influences the proprioceptors in the ankle joint [37].

We chose to compare between the functional corrective and muscular inhibitory KT application especially as they are the most applications used in previous KT researches.

Iosa et al. agreed with our study results as they revealed in that the functional taping application is very promising in management of children with CP due to the great results concerning the motor functional abilities [38]. That is also confirmed by study by Karabay et al. that proved the ability of KT to improve gross motor function in children [39].

KT was found to be very effective in children with spastic CP in level I and II in the gross motor functional classification system and showing improvement in the gross motor abilities of the child [40], another study showed that KT application accompanied with rehabilitation program have a great beneficial for children with spastic CP especially in the first and second level on the GMFCS [19], that why the current study select the children in level II in GMFCS.

In the contrary, our study results disagreed with Ekiz et al.' study that showed no functional effect of the KT application [41]. Also, another study

stated that there was no direct effect of KT application on the gross motor function [42].

5. CONCLUSION

According to the study results, it is concluded that muscle inhibitory and functional KT applications have the same effect on improving the gross motor abilities in children with spastic CP, so both can be used for increasing the gross motor functional abilities of children with CP with no favour to any of them.

6. RECOMMENDATION

Although our study was designed to be comparative randomized clinical trial comparing between the two techniques, we suggest that in further researches a control study be added to allow the study design to be randomized control trial. That will strengthen further studies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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