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Is the use of Kinesio Tape (KT) effective in improving gross motor functionality throughout the sit-to-stand transfer activity in children with cerebral palsy (CP)?

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A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

In Partial Fulfillment of the Requirements For

The Degree of Master of Science

In

Health Sciences – Physician Assistant

Department of Physician Assistant Studies
Philadelphia College of Osteopathic Medicine
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ABSTRACT

Objective: The objective of this selective EBM review is to determine whether or not Kinesio tape (KT) is effective in improving gross motor functionality throughout the sit-to-stand transfer activity in children with cerebral palsy (CP).

Study Design: Review of three English language primary studies published between 2011 and 2015.

Data Sources: One not-blinded randomized controlled trial (RCT), one single-blind RCT, and one cross-sectional study were found using the PubMed database.

Outcomes Measured: The outcomes that were measured were improvement in gross motor function, sitting posture, functional independence, balance, ambulation, and agility from sitting to standing. This was done by utilizing the gross motor function measure sitting subscale, independence measure for children, sit-to-stand transfer activity measurement, timed-up-and-go test, sitting assessment scale, and pediatric balance scale, all of which focused on improvements in motor function with the application of KT.

Results: In a not-blinded RCT by Simsek et al (2011), there was no observed direct effect of KT on gross motor function and functional independence. However, they found that sitting posture, including head, neck, foot position, arm position, and hand function, were positively affected with the utilization of KT. This may potentiate the findings of other studies showing the beneficial effects on postural alignment in sitting. The Kaya et al (2015) study found that taping improves short-term muscle power, functional muscle strength, and gross motor function, thereby showing an improved execution of the sit-to-stand movement. Additionally, a cross-sectional study by da Costa et al (2013) demonstrated that participants had a significant improvement in their sit-to-stand transfer activity under the condition of taping. This was reflected by a decrease in execution tine, reduction in ankle flexion peak, and greater knee extension at the end of the movement.

Conclusions: Based on these three trials, the application of KT in children with CP was found to be effective in improving sitting posture, and postural control throughout the sit-to-stand transfer activity. Improvements in more generalized gross motor functionality and muscle power are not conclusive. Each study demonstrated benefits with taping when participants underwent their routine course of physiotherapy.

Key Words: Kinesio taping (KT), cerebral palsy (CP), and children

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INTRODUCTION

The Kinesio tape (KT) method was originally developed in the 1970s by Dr. Kenzo Kase, a practitioner licensed in acupuncture and chiropractic medicine.[1] His development of the tape was prompted by limitations he encountered by working with existing sports taping methods on patients with conditions such as arthritis, or overuse injuries. It was through trial and error with supplies of numerous athletic tapes that he realized the source of his patient's complaints were in the muscle, not in the joint or bone. Therefore, he felt that in order to stabilize the joint, it was more effective to tape around the muscle, thus achieving joint correction.[1] Dr. Kase also knew that with overuse injuries muscle loses elasticity, and he decided that he needed to develop a tape with the same elasticity as healthy human muscle. One of the theoretical benefits of KT is that it can correct the alignment of weak muscles as well as facilitate joint motion due to its recoiling properties.[1]

Cerebral palsy (CP) is a neurological disorder caused by malformation, or non-progressive brain injury that primarily affects body movement and muscle coordination.[2] CP is classified according to the main type of movement disorder involved; spasticity, dyskinesia, or ataxia.[3] It is the most common movement disorder in children, a fact which demonstrates its relevance to patients and physician assistant (PA) practice.[3] The Centers for Disease Control and Prevention (CDC) estimated that an average of 1 in 323 children in the United States (US) have CP. Additionally, according to the CDC and international population-based studies, 1.5 to 4 children out of every 1,000 live births have CP.[3] An individual with CP will show signs of physical impairment and movement dysfunction such as abnormal muscle control, coordination, reflexes, and balance, affecting their arms, legs, and face. Many CP patients also have related

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conditions such as intellectual disabilities, seizures, vision, hearing, or speech problems, changes in the spine, or joint contractures.[3]

Living with CP places a large economic burden on the patient's caregivers. According to the CDC, in 2005 medical costs for children with CP alone were 10 times higher than for children without CP. Additionally, medical costs for children with both CP and an intellectual disability were 26 times higher than children without CP; demonstrating the cost disparity amongst children enrolled in Medicaid in 2005 with a diagnosis of CP.[3] There is no exact total healthcare cost numeric for CP, however the CDC has estimated the lifetime cost to care for an individual with CP to be nearly $1 million.[3] It is difficult to estimate yearly healthcare visits among individuals with CP. In 2007, it was found that annual rates of outpatient physician visits for youth with CP were 2.2 times higher than rates for their age-matched peers.[4] Similarly, annual hospital admission rates in 2007 were found to be 4.3 times higher than rates for their age-matched peers.[4]

CP is not a disease, but a group of permanent movement disorders, that are not degenerative or life-threatening. While the associated abnormal muscle control and coordination difficulties are prominent symptoms resulting from brain damage which occurred during brain development, the exact etiology is not known.[5] In addition, there is currently no known existing treatment for the reversal of the brain damage which causes CP. Patients with CP require long-term care with a medical team consisting of neurologist, orthopedic surgeon, physical therapist, occupational therapist, and speech-language pathologist.[6] Muscle relaxants such as diazepam, dantrolene, baclofen, and botulinum toxin, and anticonvulsants such as lamotrigine and oxcarbazepine are two classes of medications used to treat symptoms of CP.[6] A surgical

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procedure where nerves serving the spastic muscles are severed is performed when other treatments fail.[6]

The medical treatments outlined above may lessen muscle tightness and improve functional abilities, however, medication selection varies whether the problem is isolated or generalized, and based on known drug treatment risks. KT, designed to replicate the elastic properties of human skin, can be used as an additional treatment in order to improve locomotion, trunk stability, postural control, and support for weak muscle.

OBJECTIVE

The objective of this systematic review is to determine whether or not KT is effective in improving gross motor functionality throughout the sit-to-stand transfer activity in children with CP.

METHODS

A not-blinded RCT, single-blind RCT, and cross-sectional study were used to investigate the effectiveness of KT on gross motor function in patients with functional limitations. The population criteria for the selected studies was limited to children ages fourteen and under with CP. The only intervention tested was the application of KT; both on stationary children, and children undergoing routine physiotherapy. In all three studies selected, the comparison condition was physiotherapy, a traditional treatment for CP, without the use of KT. From the applied intervention, the measured outcomes included the efficacy of KT to enhance gross motor function in children with CP; specifically in sitting posture and performance in the sit-to-stand transfer activity.

Each article selected was published in English, and in peer-reviewed journals found using the PubMed database accessed through the PCOM library website by the author. The articles

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were selected based on their relevance to the clinical question and their inclusion of patient oriented outcomes. The key words identified to search the appropriate publications were kinesio taping, cerebral palsy, and children. Inclusion criteria for the purpose of this paper include children under 18 years old, a diagnosis of CP, and studies published after 2000. The exclusion criteria were patients over 18 years of age and those without a definitive CP diagnosis. The test statics reported were *p-value*, mean ± standard deviation, and mean change from baseline. The demographics of each study included are outlined in **Table 1.**

Table 1- Demographics and Characteristics of Included Studies

Study	Type	# Pts	Age (yrs)	Inclusion Criteria	Exclusion criteria	W/D	Interventions
da Costa, 2013[7]	Cross-sectional	12	9-11	Children ages 9-11, patients who were in physiotherapeutic treatment, having not underwent surgery or application of botulinum toxin for at least 6 months before assessment date, ability to understand examiner's command, diagnosed with left hemiplegic cerebral palsy level I by the gross motor function classification system (GMFCS).	Children with shortening of muscles of the lower limbs.	0	Sit-to-stand (STS) movement testing under KT and control conditions. Timed up and go (TUG) test under KT and control conditions. Pediatric balance scale (PBS), static and dynamic activities, under KT and control conditions.
Kaya, 2015[8]	RCT (single blind)	37	7-14	Age between 7 and 14, classified in levels I and II of the GMFCS, able to follow verbal instructions.	Any orthopedic surgery or botulinum toxin injection in the past 6 months, children whose parents refused to	5	The children were taped (UE and LE) 6 days per week for a total of 72 days extending over a 12 week period, the 5 cm tape was kept in position for 3 days, and then the region was left to rest for 24 hours, KT was then reapplied by the same experienced researchers for another 2 days,

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					participate, and children with allergic reactions to KT.		
Simsek, 2011[9]	RCT (not blinded)	31	6-12	CP diagnosis, rated as level III, IV, or V in GMFCS, not having participated in any previous trials with KT or other taping methods.	No previous spinal surgery, allergic reaction to KT, rated as level I or II in GMFCS, or inability to understand the commands necessary for the procedure.	1	KT was applied longitudinally between S1 and C7 to the paraspinal musculature, fan technique applied using a 5 cm KT, tape held in position for 3 days and then the region was left to rest for 24 hours, KT was reapplied by the same physiotherapist for another 3 days. This continued for 12 weeks with 1 hour sessions of physiotherapy 3x per week for 12 weeks.

OUTCOMES MEASURED

In the da Costa et al. study, the main outcome measured was the sit-to-stand transfer activity using the STS movement test, PBS, and TUG test, all under the application of KT performed by non-blinded researchers. The STS transfer activity is one of the most commonly executed movements and is fundamental to upright mobility and daily living.[7] Kaya et al. aimed to define the use of KT to improve short-term muscle power, functional muscle strength, and aid in independent activities of daily living. The gross motor function measurement (GMFM), the functional independence measure for children (WeeFIM), and the STS body function tests were used to quantify the outcomes by researchers who were blind to the randomization of participants into the control and taping groups. Simsek et al. also used the GMFM and WeeFIM, in addition to the sitting assessment scale (SAS) as outcome measurements. It was hypothesized that the use of KT could improve CP patients' postural control system, which cannot effectively control the

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body's position and motion in space due to an inability to generate appropriate muscular force.[9] All assessments and randomization were conducted by a single physiotherapist.[9]

RESULTS

Within the articles selected for systematic review, all three contained studies that were conducted with the control group undergoing the same routine traditional physiotherapy for CP as the experimental group.

da Costa et al. executed their cross-sectional study using a sample size of 4 children; 2 boys and 2 girls. For the STS activity, subjects rose to stand at their preferred speed while watching a standing eye level target. After the STS task, dynamic and postural control were tested using the PBS. The PBS has 14 items of increasing difficulty used to test functional skills relevant to everyday tasks such as moving from sitting-to-standing and reaching beyond one's support base.[7] The goal was to show that KT can improve proprioceptive and tactile information and restore optimal muscle length. Not-blind researchers scored the items from 0-4, with a higher score indicating better balance abilities. There were 8 dynamic activities, with a maximum score of 32 points, and 6 static activities with a maximum score of 24 points. Lastly, the TUG test had each child positioned in a height-adjustable chair with subject's hips and knees flexed to 90°. The children were given a "go" cue and instructed to stand up, walk 3 meters, turn around, walk back, and sit down. There were 3 recorded trials with a 30 second (s) break in between.[7]

A total of 24 attempts on the STS movement were collected. The average time under controlled conditions was 2.41 s which decreased to 1.61 s under the KT condition. A *p* valued of 0.022 was determined. This is significant as the authors write, "there was a significant improvement in the performance of STS, which was reflected by the decreased time of execution, reduction in ankle flexion peak, and greater knee extension at the end of the

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movement."[7] In analyzing the PBS static scores, an increase in mean PBS-static score from 16.6 under controlled conditions to 17.7 in the KT condition was found. This difference is not statistically significant, $p = 0.102$.[7] The increase found in the PBS-dynamic score between the comparison group and KT group was statistically significant, $p = 0.0043$.[7] There was an increase in mean PBS-dynamic score from 24.0 to 28.5. The average value obtained in the TUG test was also statistically significant, $p = 0.048$, with an average value of 20.09 seconds under controlled conditions, decreased to 12.36 s with the application of KT.[7] The results suggest the effectiveness of neuromuscular taping in agility from sitting-to-standing and ambulation. There were no statistically significant differences seen in PBS-static scores under controlled and experimental conditions. Therefore, it is suggested that the properties of KT are effective for activities requiring dynamic postural control.[7] There were no participants excluded from the final results, however, the sample was limited to 4 children, all having left hemiplegic CP level I.

Table 2: Changes in gross motor functionality illustrated in da Costa et al study.[7]

Type of Measurement	***p-value***	**Control condition**	**KT**
STS (seconds)	0.022	2.41 s	1.61 s
PBS-static	0.102	16.6	17.7
PBS-dynamic	0.043	24.0	28.5
TUG (seconds)	0.048	20.09 s	12.36 s

Thirty-seven children with unilateral spastic CP were randomized to the taping group or control group in the Kaya et al. study. Eighteen participants comprised the taping group, and seventeen the control group. Both the upper and lower extremities were taped, and both groups received routine traditional therapy twice a week consisting of neurodevelopmental treatment.[8] Treatments included stretching, weight-bearing, reaching, and walking. The statistically significant scores demonstrated in the sit-to-stand, GMFM, and WeeFIM scores show there was

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an improvement in functional muscle strength and power, therein positively affecting gross motor capacity. The WeeFIM results specifically exhibit improvements in patient's self-care, mobility, and locomotion. The mean change from baseline before KT was 113 (91-119) and after, 116 (104-120). For GMFM walking, running, and jumping, the mean change from baseline before KT was 95.83 (91.66-98.61), and after, 97.22 (97-100). The complete sit-to-stand values increased to 11 (9-13) after the application of KT, from 9 (7-12) before. The researchers connected the STS results from the da Costa et al. study to their own STS results. In reference they stated, "da Costa et al. clarified the reason for this improvement as better postural orientation leading to the development of postural control, greater knee extension, and less ankle flexion at the end of STS movement, and better stabilization in the gravity centre."[8] In examining their results, the researchers believe that the KT could be stimulating mechanoreceptors in children with unilateral spastic CP, thus improving proprioceptive inputs for muscles to perform task-specific functions.[8] Only one individual in the eighteen-person taping group was excluded from the final results after having an allergic reaction to the tape.

Table 3: Changes in gross motor functionality in patients with unilateral spastic CP in the Kaya et al. study.[8]

Measurement Categories	**Before Median (25-75%)**	**After Median (25-75%)**	***p-value***
WeeFIM	113 (91-119)	116 (104-120)	0.001
GMFM	95.83 (91.66-98.61)	97.22 (97-100)	0.005
Sit-to-Stand	8 (7-12)	11 (9-13)	0.004

In the Simsek et al. study, 30 children with CP receiving regular physiotherapy were randomly allocated into a control group and study group. For this specific study, KT was utilized

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to enhance normal postural alignment by facilitating trunk stability. Researchers aimed to decrease functional dependency.

The GMFM is an observational assessment tool that was used to evaluate gross motor function across five domains; lying and rolling, sitting, crawling and kneeling, standing, and walking.[9] In estimating treatment effectiveness, $p = 0.127$, which shows that the application of KT to trunk musculature did not have a statistically significant effect on gross motor function. WeeFIM, is an 18 item tool used to evaluate functional independence across six domains related to activities of daily living; sphincter control, transfers, locomotion, communication, and social cognition.[9] The results after KT application were not statistically significant, $p = 0.954$. Therefore, KT did not have an effect on independence in activities of daily living. The third outcome measured, sitting assessment scale (SAS), a standardized observational instrument designed for the assessment of sitting in children with CP had a *p-value* of 0.003.[9] This value is statistically significant and demonstrates the effectiveness of KT on postural alignment in sitting. Sitting posture, including head, neck, foot, arm, and hand function were affected positively. The participants in the study were closely monitored for the development of any skin irritation due to the application of KT, and only one participant was excluded.

Table 4: Changes in sitting posture, gross motor function, and functional independence in subjects within the Simsek et al study.[9]

GMFM		
	Mean ± Standard Deviation	*p-value*
KT group	61.66 ± 22.56	0.127
Control Group	75.66 ± 25.12	
WeeFIM		
	Mean ± Standard Deviation	*p-value*
KT group	55.53 ± 28.9	0.954
Control Group	54.93 ± 27.73	
SAS		

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	Mean ± Standard Deviation	*p-value*
KT group	13.20 ± 3.32	0.003
Control Group	16.47 ± 1.96	

DISCUSSION

One of the important benefits of analyzing KT as a potential therapeutic treatment for CP is that it is inexpensive and widely available at pharmacies and superstores. While it was difficult to find definitive criteria, it is evident that KT can be applied by certified practitioners with their services billed to insurance companies, thus eliminating some of the patient's financial stress. KT is latex free, and its cotton fibers allow for evaporation, leading to a longer wear time of up to 4 days.[1] To expand upon the known benefits of KT on gross motor function, the three studies investigated in this paper were the first to research the effects of KT use in patients with CP.

There are many inherent limitations in the three studies. A significant limitation in the da Costa et al. study is the 4 child sample size and lack of placebo condition.[7] All participants performed the tests under both taping and controlled conditions, in a randomized order. In the Kaya et al. study, of the 37 children selected to participate, 2 in the control group did not attend the final evaluation, and 3 study group participants were lost; 1 due to allergic reaction and 2 due to unexplained discontinuation of treatment.[8] This limits the certainty with which conclusions can be drawn from the data collected. The Simsek et al. study was limited due to its assessments being conducted after the tape was removed. While there are existing studies with the evaluations having been conducted with KT still on the body part, it would be recommended in future studies to evaluate under both conditions; prior to, and post-removal of KT. This would show if there was a weaning effect of KT.[9] An important inadequacy was the fact that the control and KT groups were not homogenous in terms of their clinical type of CP. Different clinical

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types of CP naturally respond differently to KT application.[9] Fortunately, all of the Simsek et al. subjects did have a similar level of postural control in relation to sitting posture.

CONCLUSIONS

In analyzing the data collected from the three studies chosen for review, the results are inconclusive. All three studies used varying mechanisms and approaches to examine postural control, gross motor function, and muscle power through dynamic and static activities. One commonality found is that KT had a clinically significant, positive affect on sitting posture and the movement from sitting to standing in children with CP. Therefore, KT improves performance in sitting to standing. It is important to note that all three studies are pioneers in evaluating the immediate effect of KT in children with CP. The true improvement in gross motor function among patients with CP is still not clearly defined, as only the Kaya et al. study resulted with KT having a positive effect on muscle strength and power, and gross motor function. Further research needs to be conducted on the effectiveness of KT with physiotherapy, to aid balance impairments, spasticity, and weakened muscle power and agility, all of which limit activities and diminish body functions in children with CP.

There are many flaws in the methods that can be improved in future research endeavors. Put simply, there needs to be larger sample sizes with long-term participant follow-ups. All three of the studies were conducted outside of the US, therefore, it would be beneficial to both attempt to replicate studies in the US and redesign new studies with fewer research limitations. Within the US, KT is widely used among athletes and individuals with chronic pain and functional limitations. Future studies, conducted in both the US and internationally, are warranted to evaluate the effectiveness of KT on children with different clinical types of CP before routine use can be widely recommended or supported.

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REFERENCES

1. About Us. KINESIO: The Original from Dr. Kenzo Kase Since 1979. https://kinesiotaping.com/about/. Updated 2016. Accessed November 27, 2016.
2. What Is Cerebral Palsy?. My Child: Cerebral Palsy Foundation. http://www.cerebralpalsyfoundation.com/what-is-cerebral-palsy.html. Updated 2016. Accessed November 27, 2016.
3. Data & Statistics for Cerebral Palsy. Centers for Disease Control and Prevention. http://www.cdc.gov/ncbddd/cp/data.html. Updated May 6, 2016. Accessed November 27, 2016.
4. Young NL, Gilbert TK, McCormick A, Ayling-Campos A, Boydell K, Law, M, et al. Youth and Young Adults With Cerebral Palsy: Their Use of Physician and Hospital Services. *Arch Phys Med Rehabil.* 2007;vol 88:696-702. http://www.archives-pmr.org/article/S0003-9993(07)00198-0/pdf. Published June 2007. Accessed October 3, 2016.
5. Cerebral palsy: Symptoms and causes. Mayo Clinic. http://www.mayoclinic.org/diseases-conditions/cerebral-palsy/symptoms-causes/dxc-20236552. Updated August 25, 2016. Accessed October 3, 2016.
6. Cerebral palsy: Treatment. Mayo Clinic. http://www.mayoclinic.org/diseases-conditions/cerebral-palsy/diagnosis-treatment/treatment/txc-20236572. Updated August 25, 2016. Accessed October 3, 2016.
7. da Costa CS, Rodrigues FS, Leal FM, Rocha NA. Pilot study: Investigating the effects of kinesio taping(R) on functional activities in children with cerebral palsy. *Dev Neurorehabil*. 2013;16(2):121-128. doi: 10.3109/17518423.2012.727106 [doi].
8. Kaya Kara O, Atasavun Uysal S, Turker D, Karayazgan S, Gunel MK, Baltaci G. The effects of kinesio taping on body functions and activity in unilateral spastic cerebral palsy: A single-blind randomized controlled trial. *Dev Med Child Neurol*. 2015;57(1):81-88. doi: 10.1111/dmcn.12583 [doi].
9. Simsek TT, Turkucuoglu B, Cokal N, Ustunbas G, Simsek IE. The effects of kinesio(R) taping on sitting posture, functional independence and gross motor function in children with cerebral palsy. *Disabil Rehabil*. 2011;33(21-22):2058-2063. doi: 10.3109/09638288.2011.560331 [doi].

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