

Does Kinesio Taping of the abdominal muscles improve the supine-to-sit transition in children with hypotonia?

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INTRODUCTION

Hypotonia is defined as a decrease in muscle tone (amount of a muscle's resistance to movement). There are many reasons why a child can present with overall decreased muscle tone. Hypotonia can be congenital (present at birth) or acquired (onset after birth). It is usually a manifestation of a more significant disorder such as central nervous system dysfunction, genetic disorders, muscle disorders or developmental delay. Hypotonia can also be acquired secondary to an infection, autoimmune disorder, brain injury or other traumatic incident.

In a study by Martin et al. (2007), physical and occupational therapists were surveyed regarding the most common clinical characteristics of hypotonia, examination tools, interventions and prognosis in the pediatric population. Common clinical characteristics included: decreased strength, hypermobile joints, increased flexibility, delayed motor skills, leaning on supports, rounded shoulders, decreased activity tolerance and decreased attention/motivation. They concluded that the most common characteristics are decreased strength, hypermobile joints and increased flexibility.

In addition, Martin et al. also state "most clinicians (85.4%) indicated that characteristics observed with hypotonia improve with therapy, while only 14.6% reported no improvement." While it is not possible to change tone, various therapeutic techniques can be utilized to improve the overall functional ability of children with hypotonia. Such techniques include, but are not limited to, muscle strengthening, sensory stimulation, gross/fine motor skill training and breathing exercises.

Various studies have researched the use of Kinesio Tape (KT) as an effective adjunct to a conventional rehabilitation program; however, no specific research on the use of KT as an adjunct to traditional physical therapy treatments of children with hypotonia could be found.

Footer (2006) studied the effects of therapeutic taping of the paraspinal region to see if it would promote a positive functional change in seated postural control in children with cerebral palsy. No statistically significant changes were indicated as a result. Yasukawa and colleagues (2006) associated KT with improvements in upper limb control in an acute pediatric rehabilitation setting as seen by improved scoring on the Melbourne Assessment of Unilateral Upper Limb Function. According to this article, improvements may potentially be attributed to the sensory input provided by the tape. In addition, Yoshida and Kahanov (2007) determined that Kinesio Tape applied over the lower trunk may increase active lower trunk flexion range of motion. Improvements in range of motion were attributed to both increased blood circulation and stimulation of cutaneous mechanoreceptors at the taped area. Jaraczewska and Long (2006) studied the use of KT to improve upper extremity function in adults with hemiplegia. They found that the use of

KT, in conjunction with an established rehabilitation program, may help to reduce post-stroke pain, inflammation, muscle weakness and postural malalignment. Murray (2000, 2001) attributed proprioception improvements to KT use in both the knee status-post ACL repair, and for the ankle after ankle sprains.

The concept of Kinesio Taping and KinesioTex brand tape was initiated in 1973 by a Japanese chiropractor named Dr. Kenzo Kase. Despite the availability of athletic tape he was searching for a material that would more closely simulate the elasticity of human skin and muscles. In 1988, KT gained worldwide publicity when used by Japanese athletes in the Seoul Olympics. Kinesio Tape was officially introduced in the United States in 1995 and is currently used as a therapeutic technique for a large spectrum of neuromuscular, musculoskeletal and integumentary disorders in both athletic and non-athletic populations (Kase 1996).

The four major functions suggest by Dr. Kase's theory on Kinesio Tape are: to relieve pain, remove congestion of lymphatic fluid or blood under the skin, support weak muscles and correct joint malalignment.

When a muscle is inflamed the space between the skin and the muscle is compressed resulting in constriction to the flow of lymphatic fluid. This compression applies added pressure to pain receptors beneath the skin causing muscle pain. Kinesio tape acts to decrease pain and facilitate drainage of lymphatic fluids by microscopically lifting the skin. The taped portion forms convolutions in the skin that in turn increases the interstitial space. This causes pressure and inflammation to be taken off the neural and sensory receptors thus alleviating pain. Over time, pressure is removed from the lymphatic system allowing for an easier flow and drainage of fluid.

Kinesio Tape can also be applied to weak muscles to facilitate muscle contractions. The tape is applied from the origin to the insertion of the muscle. As the muscle fibers contract, the tape adds support by pulling and stimulating the skin and muscle back to the point of origin. Conversely for cramping muscles caused by overuse and over-contraction, the tape is applied from the insertion of a muscle to its origin. As muscle fibers contract, the tape will relax and slack the muscle. By reducing spasm, normalizing muscle tone and balancing muscle length ratios, KT can ultimately serve to improve joint malalignment.

Purpose

As mentioned in the introduction, the most common characteristics of children with hypotonia are decreased strength, hypermobile joints and increased flexibility. These characteristics can greatly impact basic gross motor functions such as the transitional movement of supine-to-sit. For this reason, supine-to-sit was used as an outcome measure in this study. The purpose of this study was to determine if applying Kinesio Tape to the abdominal muscles would affect the performance of the supine-to-sit transition in children with hypotonia.

METHOD

Participants

Five children (4 males, 1 female, 3-10 years of age) from a special education school in New Jersey were selected by their primary physical therapists to participate in

the study (Table 1). The children had to meet the following inclusion criteria: (1) the individual presented with hypotonia in the abdominal area; (2) had difficulty with transitioning from supine-to-sit; and (3) had adequate receptive language skills to be able to understand the commands. Participants were excluded from the study if they: (1) demonstrated an allergic reaction to the KT; (2) presented with additional neurological or orthopedic impairments which would prevent them from performing the supine-to-sit maneuver; and (3) were unable to understand the commands or cues necessary for the procedure.

Table 1.
Demographic Data for Subjects

Subject #	Sex	Age	Diagnosis
1	F	5	Undiagnosed
2	M	3	PDD
3	M	3	Borderline PDD
4	M	10	Fragile X Syndrome
5	M	6	Global Developmental Delay

Procedure

The study was performed over a five week period with application of the KT scheduled for every Tuesday. Pre and post-test measures were taken on the first and fifth week respectively with the tape off. Before the onset of the study, an informed consent form (Appendix 1) was sent to the parents/guardians of the subjects explaining the purpose of the study and the concepts and uses of Kinesio Tape. In addition, a small sample of tape was attached to the form to allow for full understanding of the appearance of KT before initiating the study. Once the informed consent was obtained from the parents/guardians, a test patch was applied to the subjects on the skin between their scapulae. A second letter (Appendix 2) was sent home explaining the purpose of the patch, directions on how to maintain it, or how to remove it if an allergic reaction should occur.

A certified KT (K1-K3) staff physical therapist instructed two third-year student physical therapists and two staff physical therapists (PTs) on the proper application technique of the Kinesio Tape. During each taping session, there were present at least two trained individuals to assist in application of the tape, videotaping, and/or cueing or assist if necessary. One of these individuals was a student PT and one was a staff PT. This was done to ensure proper application and consistency.

The KT application technique in this study was derived from Yasukawa and Martin's 2006 Pilot Study. The technique requires the use of two pieces of KT with a width of 2 inches and a length dependent on each subject by measuring the length determined by measuring each subject from the anterior superior iliac spine (ASIS) to the 10th rib. Once measured, the two pieces of tape were cut into a "Y" shape, and applied across the internal and external obliques (Figure 1). Application of this technique requires hyperextension of the abdominal area to elongate the soft tissue and muscles. Depending on the subject's tolerance, they were either positioned in standing with their arms raised or supine on the physio-roll (peanut shaped) to facilitate this position. The KT was

applied over the abdominal area with no tension starting from the origin and ending at the insertion. However, a total elastic stretch of 5-10% was present by simply taking the tape off the paper-backing during application. This minimal tension is called “paper-off” tension (Kase et al. 2006). It is also important to note that the KT did not cover the umbilicus in order to avoid build up of fluid in the cavity.



Figure 1. KT of abdominal internal and external obliques

The procedure was performed in a quiet room, instead of the typical physical therapy gym, in order to eliminate distractions and allow for optimal videotaping. The child was instructed to sit on a physio-roll positioned in front of a stack of floor mats. The mats created an extended flat surface to accommodate the supine-to-sit position and to eliminate the individual's fear of moving backwards into supine (Figures 2 and 3). The size of the physio-roll was chosen based on the size of the child while ensuring foot placement on the floor. Once positioned correctly, the individual was instructed to perform five supine-to-sit transitions with as little assistance as possible. The individuals were provided with gestural cues to sit up, minimal physical prompts to return to supine, and support was applied to their lower extremities in order to maintain the sitting position while transitioning from supine to sit.

The tape was then applied using the technique described above. It is important to note that the KT technique was used as an adjunct to regular scheduled physical therapy sessions; however, the therapists avoided practicing the transitional movement of supine-to-sit.

Outcome Measures

Supine-to-sit transition as seen on videotape:

The individuals participating in the study were required to perform the transitional movement of supine-to-sit five times before the KT application. This task was videotaped on both the first and last day of the study. Careful analysis of the pre-test videos was conducted to assess the child's ability to perform the supine-to-sit transition. Four compensatory movements were noted amongst the subjects, which included: trunk rotation to one side, use of upper extremities for support, head lag and increased lumbar lordosis (arching of the low back). The post-test video was also reviewed and compared

to the pre-test video. Figure 2 illustrates a still frame from the pre-test video while Figure 3 is from the post-test video.



Figure 2. Still frame image from pre-test video



Figure 3. Still frame image from post-test video

Questionnaire:

A questionnaire (Appendix 3) was formulated for this study in order to obtain information from the parents/guardians and teachers. The questionnaire consisted of a yes/no check off list along with additional space to write any observed changes in the following areas: (1) behavior; (2) focus and attention; (3) posture; (4) body awareness; and (5) any other additional relevant findings. This questionnaire was distributed after the final application of KT. The information obtained from the questionnaire provided additional data to compare with the physical therapists' observations.

RESULTS

Supine-to-sit transition as seen on videotape:

Movement compensations during the supine-to-sit transition for both the pre and post-tests are listed in Table 2. They include: trunk rotation, upper extremity (UE) support/assist, head lag and increased lumbar lordosis. The compensations present were recorded based on five trials. It is evident from the table that all students demonstrated some improvements in movement compensations from the use of the KT. Subjects 1, 4 and 5 improved in 2 areas, subject 2 improved in 3 areas and subject 3 improved in 4 areas.

Table 2.
Movement Compensations (out of 5 trials)

Compensations	Subject 1 *		Subject 2		Subject 3		Subject 4		Subject 5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Trunk Rotation	3/3	0/3	5/5	3/5	5/5	3/5	3/5	1/5	5/5	5/5
UE Support/Assist	3/3	3/3	5/5	3/5	5/5	3/5	3/5	1/5	3/5	4/5
Head Lag	2/3	1/3	3/5	0/5	3/5	0/5	0/5	0/5	1/5	0/5

↑ Lumbar Lordosis	0/3	0/3	0/5	0/5	3/5	0/5	0/5	0/5	3/5	1/5
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*subject #1 only tolerated 3 pre and post test trials of supine-to-sit

Questionnaire:

The questionnaire provided further information regarding the individuals' presentation outside of the physical therapy sessions. Only seven out of the ten forms were returned. Based on observations from the parents/guardians and teachers, two out of five subjects demonstrated improvements in the areas listed on the questionnaire.

The teacher reported a positive in posture for subject 2. It was documented that he "...does seem to stand a bit better and does not stick out his stomach as much." In addition, a change in both behavior and focus/attention was noted in subject 5 by his parents. They reported: "After the first taping he went to oral motor therapy and had a great session. This was after weeks and weeks and sessions and sessions that have been very unproductive due to refusal to cooperate, acting out behaviors and very little speech work."

DISCUSSION

The results of this study demonstrate improvements, by means of less compensatory movements, in all five subjects as seen on the videotape. In addition two out of the five subjects improved in other areas as reported on the questionnaires by the parents/guardians.

Results can only include the collected data from the two outcome measures designated at the start of this study. However, other health care professionals in the school observed positive changes in the subjects' performance so we feel it is important and relevant to note these observations. Two occupational therapists (OTs), who provide services for subjects 4 and 5, were asked to complete the identical questionnaire distributed to the parents/guardians and teachers. Their input was not included with the results since it was not part of the original proposal. Both therapists commented on improvements made while one was unaware of the study that took place. The OT who regularly treats subject 5 reported an increase in both focus/attention and posture. She documented that the subject "only physically redirected his head two times while walking to OT (usually his head constantly turns)." In addition, she noted that the subject demonstrated more control of his trunk from his neck to his hips, ("usually [his] whole body is fluid like waves).

While evaluating these findings, it is important to be aware of several limitations in this study. First, KT can be worn for 3 to 5 days. In this study, only two subjects were able to keep the tape on for two consecutive days (one keeping it on for 3 days). The other three subjects removed the tape on the same day in which it was applied. One explanation for this is that the subjects in the study may present with various sensory processing issues including sensory defensiveness that may contribute to their Autism or PPD diagnoses. Therefore, wearing the tape could have been uncomfortable due to their hypersensitivity. In addition, some children fixate on things that are not part of the normal routine. The tape was not something they normally wear; therefore, they were inclined to peel it off.

Another limitation in this study may have been the use of the physio-roll. Performing the supine-sit transition on a physio-roll could have been more difficult than performing the same transition on a flat surface. Children possibly felt a lack of security while sitting on the roll or the size may not have been completely appropriate for performing this motion. It is also important to note that the amount of assistance provided by the therapists to the subjects lacked uniformity throughout the course of the study. While care was taken to provide only minimal assistance to guide the subjects through the motion, many variables such as the force of upper extremity assistance, the amount of verbal cueing and the stabilizing force of the subjects' lower extremities all must be considered.

Finally, the format of the questionnaire distributed to the parents/guardians and teachers is another limitation to this study. The form laid out specific areas introducing bias. Listing specific variables biased individuals to comment on areas of the subjects' performance that they may not have thought of without the form. On the other hand, this specific list of questions also limited the responses by focusing on only those given areas. For example, one teacher checked off "no improvements" on all five areas of the questionnaire. Further discussion with this teacher demonstrated that in fact she did see improvements in areas not listed on the form. Distribution of this form to other clinicians including the occupational and speech therapists of the subjects may have also been beneficial in data collection.

CONCLUSION

In this study, the use of Kinesio Tape on the abdominal muscles proved to be an effective therapeutic intervention for improving the transition of supine-sit in children with hypotonia. Children presented with favorable findings including: less compensatory movements during the transition, increased focus/attention and decreased protruding abdomen. Care should be taken when applying this information to other populations in different settings. Further research in this area is suggested to further confirm these findings regarding the use of Kinesio Tape on pediatrics with hypotonia.

Recommendations for future research

To further advance the level of data collection, goniometric measurements of trunk rotation, lumbar lordosis, and head lag can be obtained from the video monitor. This can be accomplished with specific placement of markers on the individual and by ensuring videotaping is done at the same angle. If available, a movement analysis system would be ideal.

Although this study showed an association between KT of the abdominal muscles and improvements in the transition of supine-to-sit in a pediatric population with hypotonia, further research studies should (1) compare the use of KT with a control group, (2) measure the effectiveness over a longer period of time while eliminating the confounding variable of children removing the tape on their own, (3) examine other objective outcome measures to further evaluate the effectiveness of KT.

Acknowledgements

Kinesio Tape Association for providing the tape for this study.

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APPENDIX 1: Consent Form

HOME SCHOOL COMMUNICATIONS RE: Therapy Interventions

Date:
Student:
Therapist:
Memo: Permission to use Kinesio Tape

Kinesio Taping is a technique physical and occupational therapists are using to achieve their goals of improving body alignment, muscle balance, and function. Its effectiveness is based on the body's own natural healing process, plasticity of the central nervous system, and activation of the neurological, circulatory and sensory systems. The process involved application of strips of tape applied in specific locations on the body surface, with defined tensions and directions to facilitate function of the underlying muscles. Kinesio Tape can improve joint stability and increase body awareness. We anticipate improved posture, balance, gait and movement skills. By wearing the tape for several days your child's therapy session is supported between sessions...much like "sending the therapist's hands home or back to class."

Enclosed is a small sample of the tape for you to see and experience if you wish to apply it to yourself. It can be worn in the shower or tub and should remain in place for a minimum of three to four days, with a maximum of seven days of wear time. Kinesio Tape is latex free, and comfortable to wear. It is stretchy and has a thickness that is approximately that of our skin. Please check off the appropriate lines below indicating your wishes regarding using Kinesio Tape with your child. If you have any questions please call us at NAME OF SCHOOL (PHONE NUMBER).

Thank you in advance for your ongoing support.

My child may participate in the Kinesio Taping program as described above_____.
I prefer NOT to have my child participate in the Kinesio Taping program at this
time_____.

Parent Signature

APPENDIX 2: Second letter to parents

To: Parents or Guardians of _____

From: _____

Re: Kinesio Tape

Date: _____

+

Kinesio Tape has been applied to your child's _____ today. The purpose of this tape technique is:

_____ This tape is a test patch and should be left in place ____ days. It should be removed immediately if any irritation occurs including redness, swelling or itching.

_____ Assisting in holding a joint in a position so an overstretched muscle is provided time to shorten.

_____ Providing tactile (sensory) input to increase proprioception or awareness of a muscle or joint.

_____ Assisting in relaxing an overused muscle to allow for more ideal alignment through a joint.

Wearing of Tape:

_____ This tape is a test patch and should be left in place _____ days. It should be removed immediately if any irritation, redness or itching occurs.

_____ This tape is a therapeutic technique and should be left in place _____ days if possible. Please watch area closely and remove tape should any irritation occur including redness, or itching. * Tape can get wet in baths. Following getting wet, simply pat dry with a towel. DO NOT DRY WITH HAIRDRYER as excessive heat will make removal difficult. It tape begins to roll on the edges, simply trim off excess to prevent it from getting caught on clothes and being pulled off more.

Removal of tape:

* For easiest removal, place a thin layer of baby oil or vegetable oil over taped area. Let soak for 10 minutes and then loosen one end and begin peeling the skin away from the tape. DO NOT PULL THE TAPE OFF THE SKIN IN A QUICK MOTION. Removal during a bath may be the easiest. * After removal, use plenty of lotion to hydrate the skin. * If you have any questions or concerns please call at the SCHOOL between 9:00 and 9:30 AM or 2:30 and 3:00 PM. Thanks in advance for your support with this therapy.

APPENDIX 3: Questionnaire

To: Parents/Guardians and teachers of _____
From: Physical Therapy
Re: Kinesio Tape Study
Date: April 15, 2008

As you are already aware, the physical therapy department has been conducting a study investigating the use of Kinesio Tape on the children's abdominal muscles for the past few weeks. We are approaching the conclusion of the study and would appreciate your

input regarding the effectiveness of the tape. This feedback is an important component of our research that will assist us in the compilation of our data and modifications for future research studies.

Please take a few minutes to complete this questionnaire. It would be greatly appreciated if you can return this questionnaire by **Thursday, April 17, 2008**.

Thank you for your participation in our research study.

Have you noticed any changes in the following areas regarding your child/student's:

	Yes	No	If Yes, please explain:
1. Behavior	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____ _____
2. Focus/ attention	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____ _____
3. Posture	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____ _____
4. Body awareness	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____ _____
5. Other:	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____ _____