



The Effect of Neuromuscular Taping in Improving Upper Extremity Functions in Children with Cerebral Palsy

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Abstract

Background: *The purpose of this study was to examine the effect of application of Kinesiotape over the shoulder muscles to improve functions of upper extremity in children with cerebral palsy.*

Objective: *To find out the effect of kinesiotaping over the shoulder muscular along with conventional occupational therapy, in improving upper limb functions of children with cerebral palsy.*

Method: *It was a Pre Test and Post Test experimental study .60 children with cerebral palsy who were fulfilling the inclusion criteria were selected by convenient sampling. A written informed consent and ethical permission was obtained. Quality of upper extremity skill test (QUEST) was used as instrument for measuring improvement in upper extremity functions. Therapy for both the groups was given for 1 hour per session. In the experimental group along with conventional occupational therapy, kinesiotape (KT) was applied over the shoulder muscles.*

Results: *After intervention there was improvement in mean & standard deviation of QUEST more in experimental group as compared to control group.*

Conclusion: *It can be concluded that application of kinesiotape along with conventional occupational therapy can be used to enhance & improve upper extremity functions in children with cerebral palsy.*

Keywords: *Kinesiotape, Shoulder, QUEST, Cerebral Palsy.*

Introduction

Cerebral palsy (CP) is the most common cause of physical disability in childhood. It is a neurodevelopment disorder caused by non-progressive lesion(s) in the immature brain implying spasticity, muscle weakness, decreased selective motor control and secondary musculo-skeletal problems usually accompanied also by sensory and cognitive impairments (Bax M et al

2005). The upper limb is usually more severely involved than lower one in most types of cerebral palsy. (Tong-Wai R et al.2006). This limits reaching, grasping and object manipulation, interfering also with exploration, play, self-care and other activities of daily living (Jaspers E et al 2009).KT method which was first described by Dr. Kenzo Kasein 1996 is used to increase sensory stimulation, strengthen the weak muscles,

inhibit spastic muscles, increase joint stability, increase functional motor skills, help with postural control and improve functional independence in pediatric rehabilitation clinics in addition to the occupational therapy programs (Kase K et al 2006). This innovative taping application is based on eccentric stimulation of the skin, muscle tissue, tendons, neurological vessels, lymphatic and vascular pathways improving their functioning. Neuromuscular taping (NMT) provides passive stretching through the application of a tape with eccentric properties encouraging flexibility and coordination and bettering range of movement in patients suffering with excessive muscle contraction due to different clinical conditions. It has been claimed that the effects may be due to the sensorimotor and proprioceptive feedback mechanisms. It has been hypothesized that the application of NMT is able to stimulate cutaneous mechanoreceptors. These receptors activate nerve impulses when mechanical loads (touch, pressure, vibration, stretch and itch) create deformation. Their activation by an adequate stimulus causes local depolarization, which triggers nerve impulse along the afferent fibers travelling towards the central nervous system. However, few applications support the use of this type of tape to improve the upper-body functionality in CP. KT consists of noninvasive adhesive elastic taping, the purpose of which is to mechanically restrain pathological movements, to preserve functional movements at the same time, and to enhance perceptive feedbacks (Iosa M et al 2010& Thornton J Let al 1996). The aim of this study is to use kinesiotape in facilitating movements of upper extremity in children with cerebral palsy.

Methodology

This study adhered to the tenets of Declaration of Helsinki guidelines. 60 children with medical diagnosis of cerebral palsy were enrolled in this study. The Ethical Committee of university approved our protocol. Children excluded from the study were those on Botox therapy (within the past 6 months) or muscle relaxants, those with

active seizure disorders, those who had undergone any surgery for the upper limb, and those having allergic reaction to Kinesiotape. In all the subjects, shoulder muscles spasticity was lower than 2 on the Modified Ashworth Scale and passive shoulder range of motion was full, with preserved ability to actively move the shoulder in all directions. The study purpose and test procedure were elaborately explained to the parents/guardians, after which written informed consent was obtained for their child's participation. A patch test with the Kinesio tape was performed on the dorsum of the hand (to confirm or rule out subject's allergy to Kinesio tape).

Application of Kinesio tape

Tape application was performed in a quiet environment with each child's being positioned comfortably on the chair. The skin was cleaned by Surgical Spirit 70% alcohol, and then Kinesio tape was applied over the muscles belly of pectorialis major and deltoid i.e. from the upper chest to upper arm and upper back to upper arm using the "fanning" technique as shown in the figure 1. The Kinesio tape was kept on the child's shoulder for 3 days. After 3 days KT was removed and area of application was left open for 24 hours. Then again it is applied for other 3 days. This sequence was carried out for a month.

Results

Pretest and Posttest scores were collected using all the components of QUEST and were added and summed up to find the raw score and final scores. Table 1 shows that 60% of children with cerebral palsy who participated in the study were male which were 35 in number between the age range of 42-72 months and mean age of 57 ± 1.23 months. There were 25 females which are 40% of total population in the study with the age range of 36-69 months and mean age and standard deviation of 52.5 ± 2.80 . During the study we encountered 4 types of cerebral palsy children with 43 spastic diplegic, 6 spastic hemiplegic, 4 spastic quadriplegic and 7 athetoid. Table 2 shows the mean and standard deviation of subtest

dissociated movement of QUEST which shows that there was improvement in mean and standard deviation of shoulder, elbow, wrist, finger and grasp in both experimental and control group with more improvement in experimental group. Table 3 shows that there is much improvement in position of body component of grasp subtest, but there is also improvement in other 2 components of grasp 1 cube and cereal. Table 4 shows the improvement in mean and standard deviation of weight bearing in quadruped and weight bearing with reaching in this position. Table 5 shows that there is more improvement in mean and standard deviation of experimental group for protective extensions, hand function, spasticity and child seems to be more cooperative for therapy in experimental group as compared to control group according to the mean and standard deviation .Table 6 shows the results of wilcoxon sign rank test for subtest A dissociation of movement in QUEST were Z and P for experimental group is -2.877 and 0.004 respectively with level of confidence interval value of 95% .5.34 as lower limit and 10.67 as upper limit .Control group is having Z value of -2.44 and P value 0.014 with lower limit 4.16 and upper limit 7.89 and level of confidence interval value of 95%.Table 7 shows results of wilcoxon

signed rank test for subtest B i.e. grasp were experimental group is having Z value of -1.17 and P value of 0.004 with 95% confidence interval value ranging from 1.34 to 1.67.Z and P of -1.44 and 0.014 respectively for control group with 95%confidence interval value and lower limit of 1.16 and upper limit of 1.89.Table 8 wilcoxon signed rank test for component C weight bearing shows improvement in both the group the control and experimental group with Z value of -2.12 and -2.29 respectively for experimental and control group and p value of 0.004 and 0.014 respectively for experimental and control group .



Figure 1 showing pattern of kinesiotaping over the shoulder joint

Table 1. Demographic details of children included in the study.

Gender	Male	60%(35)
	female	40%(25)
Age range	Male	42 -72 months
	female	36-69 months
Dominance	Right	40%; n = 24
	Left	60%; n = 36
Involved hand	Right	46.2%; n = 28
	Left	53.8%; n = 32
Type of cerebral palsy	Spastic diplegic	43
	Spastic hemiplegic	6
	Quadriplegic	4
	Athetoid	7

Table 2.Mean and standard deviation of Dissociated movement subtest of QUEST.

Component A	Mean \pm std in control group	Mean \pm std in experimental group
Shoulder	38.03 \pm 9.61	44.19 \pm 6.80
Elbow	5.40 \pm 10.17	20.2 \pm 22.98
Wrist	22.03 \pm 14.67	36.73 \pm 16.04
Finger	88.50 \pm 24.04	99.03 \pm 21.74
Grasp	98.42 \pm 22.86	98.95 \pm 13.12

Table 3 Mean and standard deviation of grasp subtest of QUEST.

Component B	Mean \pm std in control group	Mean \pm std in experimental group
Position of body	88.50 \pm 24.04	99.03 \pm 21.74
Grasp of 1” cube	96.42 \pm 22.86	97.95 \pm 13.12
Grasp of cereal	91.03 \pm 21.74	92.92 \pm 10.90

Table 4 Mean and standard deviation of weight bearing subtest of QUEST

Component C	Mean \pm std in control group	Mean \pm std in experimental group
Weight bearing	23.80 \pm 10.04	28.80 \pm 11.03
Weight bearing with reaching	60.92 \pm 11.49	71.84 \pm 16.52

Table 5 Mean and standard deviation of subtest D, E, F, G of QUEST

Components	Mean \pm std in control group	Mean \pm std in experimental group
D. Protective extension	60.20 \pm 11.42	72.19 \pm 16.2
E. Hand function	71.84 \pm 16.52	72.85 \pm 17.41
F. spasticity	55.19 \pm 16.22	59.04 \pm 9.60
G. Cooperativeness	51.90 \pm 9.12	49.90 \pm 6.12

Table 6 Results of Wilcoxon Signed Rank Test for subtest A dissociation of movement in QUEST

Groups	Z(2 tailed)	P (2 tailed)	95% Confidence Interval Value	
			Lower Limit	Upper Limit
Experimental	-2.877	0.004	5.34	10.67
Control	-2.449	0.014	4.16	7.89

Table 7 Results of Wilcoxon Signed Rank Test for component B grasp subtest of QUEST

Groups	Z(2 tailed)	P (2 tailed)	95% Confidence Interval Value	
			Lower Limit	Upper Limit
Experimental	-1.17	0.004	1.34	1.67
Control	-1.44	0.014	1.16	1.89

Table 8 Results of Wilcoxon Signed Rank Test for component C weight bearing subtest of QUEST

Groups	Z(2 tailed)	P (2 tailed)	95% Confidence Interval Value	
			Lower Limit	Upper Limit
Experimental	-2.12	0.004	4.43	9.07
Control	-2.29	0.014	4.61	7.19

Table 9 Results of Wilcoxon Signed Rank Test of subtest D, E, F, G of QUEST

Groups	Z(2 tailed)	P (2 tailed)	95% Confidence Interval Value	
			Lower Limit	Upper Limit
Experimental	-1.06	0.004	2.34	8.67
Control	-1.14	0.014	2.16	5.89

Discussion

This paper investigates the effect of kinesiotape over the muscle belly of deltoid and pectoralis major muscles in functional outcome of upper limbs of children with cerebral palsy. The results suggest that the Kinesio tape may improve upper motor function in children with CP. Kinesiotaping enhances the kinesthetic inputs and facilitates enhanced control in the shoulder muscles to improve volitional control of the muscle and tendon movement during activities, thereby improving the functional control and movement of upper limbs, so improving fine motor hand function (Yasukawa A et al 2006). We assume that extension of the tape from chest to shoulder and from upper back to upper arm might have enhanced shoulder stability, which probably would have improved shoulder and upper arm muscle activity, hence facilitating better shoulder movement and function (Kase K et al 2003). Because the tape was retained for a month over the involved shoulder of children with CP, we assume that the anticipatory control due to the presence of the tape over the shoulder and arm muscles would have induced better muscular coordination and hence improved upper limb motor skills and hand functions. Because the kinesiotape was applied over the shoulder muscles starting from their origin and extended up to the upper area of arm till the insertion of muscles, covering the shoulder and arms, we believe that such techniques would have provided improved stability. This would have facilitated clinically positive changes in the upper limb motor functions and functions of hands. This comes in consistent with Murray 2005, who reported that neuromuscular tapping as an adjunct to the therapeutic procedures can improve strength, functional activities, proprioception, control and positioning. KT increases blood circulation in the taped area (Ogura 1998; Oliveria 1999; Vorhies 1999; Wallis 1999; Kase 1994; Kase and Hashimoto 2005; Murray 2005), and this physiological change may affect the muscle and myofascia functions after the application of

neuromuscular tapping helping the children to generate the necessary force required for the function. An additional theory is that neuromuscular tapping stimulates sensory receptors and cutaneous mechanoreceptors at the taped area. Cutaneous mechanoreceptors activate nerve impulses when mechanical loads create deformation. The activation of cutaneous mechanoreceptors by an adequate stimulus causes local depolarizations that trigger nerve impulses along the afferent fiber traveling toward the central nervous system (Garcia 2001; Goo 2001; Halseth et al. 2004; Maruko 1999; Mori 2001; Murray and Husk 2001; Ogura 1998; Vorhies 1999; Wallis 1999; Kase et al. 2003). The application of KT may apply pressure to the skin or stretch the skin, and this external load may stimulate cutaneous mechanoreceptors causing physiological changes in the taped area. Studies previously conducted to determine the effects of neuromuscular tapping on cutaneous mechanoreceptors (Garcia 2001; Goo 2001; Halseth et al. 2004; Maruko 1999; Mori 2001; Murray and Husk 2001; Ogura 1998; Vorhies 1999; Wallis 1999) have reported that neuromuscular tapping on select muscles and joints may improve muscle excitability. There is no study in the literature investigating the use of neuromuscular tape application over the shoulder and arm in improving upper limb motor functions among children with cerebral palsy.

Conclusion

It can be concluded that application of kinesiotape along with conventional occupational therapy can enhance and improve functions of upper extremity among children with cerebral palsy, so that they can have the functional independence, to meet demands of everyday life.

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