



Effectiveness of Kinesio Tape on Wrist Extensor Muscles in Children with Obstetric Brachial Plexus Injuries

Rufida S. T. Kamal-Eldeen^{1*}, Hiba A. Awooda² and Gehan M. Abd El-Maksoud³

¹Faculty of Physical Therapy, Al-Neelain University, Khartoum, Sudan.

²Department of Physiology, Faculty of Medicine, Al-Neelain University, Khartoum, Sudan.

³Department of Physical Therapy for Growth and Developmental Disorders in Children and Its Surgery, Faculty of Physical Therapy, Cairo University, Egypt.

Authors' contributions

This work was carried out in collaboration between all authors. Author RSTKE conceived, designed the study, carried out all the experimental work and wrote the first draft of the manuscript. Author HAA managed the literature searches, analyses of the study and helped to draft the manuscript. Author GMAEM identified the species of plant. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JALSI/2016/27625

Editor(s):

- (1) Purnachandra Nagaraju Ganji, Department of Hematology and Medical Oncology, Emory University School of Medicine, USA.
(2) Shahla Alalaf, Department of Obstetrics and Gynaecology, College of Medicine, Hawler Medical University, Iraq.
(3) Rohit Saluja, Department of Dermatology and Allergy, Charité – Universitätsmedizin Berlin, Germany.

Reviewers:

- (1) Ayhan Goktepe, Selcuk University, Konya, Turkey.
(2) Tiago Atalaia, Portuguese Red Cross Health School, Portugal.
(3) Timothy Hui, Loma Linda University, CA, USA.

Complete Peer review History: <http://www.sciencedomain.org/review-history/16065>

Original Research Article

Received 11th June 2016
Accepted 30th August 2016
Published 6th September 2016

ABSTRACT

Background: Obstetric brachial plexus injury (OBPI) is partial or total paralysis of the upper limb due to trauma of brachial plexus during delivery, wrist flexion is a common deformity that develops in children with Erb's Palsy. The purpose of the study was to assess the effect of Kinesiotape to stimulate the extensor muscle wrist contraction in children with Erb's palsy.

Methodology: This is a hospital-based controlled study conducted in Al-taher marzouq clinic at Khartoum, Sudan in 2015. 30 children with Erb's palsy, their age ranged from one month to three years were included in the study. They were divided into two matched groups (control and study) 15 children each. They evaluated by Active movement scale and Gilbert-Raimondi classification before

*Corresponding author: E-mail: anode.th@gmail.com, anoode.th@gmail.com;

and after fifteen successive sessions of the treatment program. Control group received selected physical therapy program and study group received Kinesiotape in addition to the program given to control group.

Results: The results of this study revealed statistically significant improvement in both group while the favor improvement in wrist extensor muscles in children with Erb's palsy in study group (Active movement scale $p=0.006$) (Gilbert Raimondi classification $p=0.02$).

Conclusion: Using the Kinesio tape in addition to selected physical therapy program is beneficial therapeutic technique to improve active wrist extension and functional activities in children with Erb's palsy.

Keywords: Erb's palsy; kinesiotape; wrist extensor; active movement scale; Gilbert Raimondi.

1. INTRODUCTION

Obstetric brachial plexus palsy (OBPP) is a disturbing form of cervical nerve injury that frequently leads to significant physical disability. Incidence ranges globally between 0.15 and 5 per 1000 live births; with the higher numbers in underdeveloped countries [1,2]. OBPP can occur during late pregnancy or delivery as a consequence of pressure or a traction injury on any of the brachial plexus parts [3]. Several studies showed a full recovery rates up to 90% with conservative treatment [4,5]. However, this rate may drop to 70%–80% with delayed monitoring of the residual deficits [4,6].

Erb's palsy constitutes a major form of OBPP; it defines as stretching of the fifth and sixth cervical roots. The typical clinical feature of infant's arm is "waiter's tip" position, where's the arm is extended, internally rotated and the wrist is flexed; with absent Moro reflex and intact right hand grasp [7,8], other causes of Erb's palsy than obstetric are rare in neonates [9], variables associated with brachial plexus injury were long deceleration phase of labor, long second stage, high birth weight, black race, and high neonatal or maternal body mass [10]. Management options range from conservative to surgical intervention. Conservative treatment available are physiotherapy, orthotics and pain control [11]. The pervious types of treatment take a long time, however deformations may occur that require surgical intervention [12,13].

Kinesio tape (KT) invented by Kenzo Kase, in Japan 1966 and introduced to United States in 1990's. It is thin and elastic tape that can be extended up to 120–140% of its original length, this elasticity result in less mechanism constraints [14,15]. KT allows a partial to full range of motion for the applied muscles and joints with different pulling forces to skin, it can be used for both muscle relaxation and to facilitate muscle contraction depending on its

application [16]. The assumption; behind therapeutic application; is by applying the flexible tape from a muscle's origin to insertion it will facilitate the muscle contraction [17,18]. In addition, Kinesio tape reported in decreasing pain with positional stimulus to the skin and muscle, as well as enhancing joint stability increase the interstitial fluids between skin and underlying connective tissues [16]. Moreover, KT stimulates the mechano-receptors in the ligaments and tendons to assist or limit motion and corrective posture by stretched tape [19]. The tape itself aids in promoting normal muscular movement and realignment of collagen synthesis during the repair and remodeling phases of the healing process that associates with improvement of the proprioception, strength, and range of motion in multiple joints [20,21].

The application of Kinesio tape depends on goals of treatment; include position of the affected area and amount of pre-stretch applied to the tape [22]. Specific cut shapes of KT are designed to allow for optimal responses. An "X" strip, "Y" strip, and "I" strip all seek various results [23]. Several studies reported the effectiveness of Kinesio tape in reducing spasticity, enhancing the dynamic activities, as well as improving extremity function and repositioning [24-26]. The aim of this study was to assess the effect of Kinesiotape on stimulation of wrist extensor muscle contraction in children with obstetric brachial plexus injury.

2. METHODOLOGY

2.1 Study Area and Population

This is a case control study conducted at Al-Taher Marzoug clinic Khartoum Sudan, from August to October 2015. Thirty children diagnosed with Erb's palsy were included in the study. They were divided into two groups: control and study 15 children each.

2.2 Inclusion and Exclusion Criteria

Children diagnosed with unilateral Erb's palsy, their age ranged from 1 month to 3 years old, both sexes were involved in the study. We excluded children with deformity or stiffness of wrist or fingers joints, neuromuscular and muscle-skeletal abnormalities other than Erb's palsy and children with positive sensitivity test for Kinesio-tape, as well as children below 1 month and above 3 years old [25].

2.3 Test and Measurement

We adopted two measurements scales (Table 1). First the Active Movement Scale (AMS) which is an ordinal scale that developed at Brachial Plexus Clinic for Sick Children, for evaluation of infants with OBPI. It is an eight-grade scale used for quantifies upper extremity strength by observing spontaneous, active movement both with and without and against gravity [27]. Second, we used Gilbert-Raimondi classification of impairment of the hand in patients with OBPL; it has 6 Grade Functions [28]. Evaluation assessments were done before and after fifteen successive sessions of the treatment program.

Table 1. Functional movement scales: Active movement scale and Gilbert-Raimondi classification

Active movement scale	
Observation	Muscle grade
With gravity elimination	
No contraction	0
Contraction no motion	1
<50% of motion	2
>50% of motion	3
Full motion	4
With gravity	
<50% of motion	5
>50% of motion	6
Full rang	7
Gilbert-Raimondi classification	
None	0
Poor	1
Fair	2
Satisfactory	3
Good	4
Excellent	5

2.4 Treatment Procedures

After adequately informing the parents about the procedure and signing an informed consent form, patients who met the inclusion criteria were assigned randomly to one of two groups: control group which received a designed physical

therapy program; and study group, which received the same therapy program in addition to kinesiotaping [29].

2.5 Physical Therapy Treatment Program

Children in both groups received the following physiotherapy treatment for 45 minute daily for 15 sessions:

- Neuromuscular stimulation, for wrist extension for 20 min.
- Facilitation of muscle contraction for all weak muscle of upper limb
- Exceoreceptor such as brushing, brief ice scratch
- Proprioceptor such as taping, approximation, quick stretch (Strengthen Exercise)
- Very gentle stretch for subscapularis, pronator and wrist flexor.
- Graduated active exercise (active assist, active free, active resist).
- Facilitate of basic hand skill (reaching, grasping, released, bilateral hand use).
- Weight bearing exercise from prone on hand, side sitting and quadruped positions [29].

2.6 Kinesio Tape Application

Before therapeutic taping was initiated, skin sensitivity test was preformed through applying a piece of kinesio tape range from 5 - 2.5 cm on the dorsum of forearm for 20 minute then removed and skin was observed for a reaction to the tape such as hyperemia or small spots, when such reactions were detected the child excluded from study. During application of the kinesio tape, the child received the designed physical therapy program according to his age and motor development.

We started with measuring the length from common extensor origin to radial styloid process then a piece of tape equal to this length for each child was taken. With the forearm in pronation and wrist with slight flexion, tape was applied from below the metacarpophalangeal joints up to the common extensor origin. Another piece of tape was applied from metacarpophalangeal of thumb to wrist joint to form Y shape with other tape. The tape was changed every session.

2.7 Data Analysis

Statistical analysis of the data was performed using SPSS soft ware for medical statistics.

Descriptive analysis was also used to analyze the samples. To examine test significance, Mann–Whitney U test used, and to test significance between the pre and post-treatment values between both groups, the Wilcoxon signed rank test was employed to detect significance between pre and post-treatment values for each group. Two-tailed p values are reported. The significance level was set at ($p < 0.05$), using Excel table.

2.8 Ethical Considerations

The research conforms to the ethical principles of medical research developed by the World Medical Association Declaration of Helsinki. Ethical clearance was given by the Research Committee (El-Neelain University), as well as written assent was obtained from children parent.

3. RESULTS

30 children (15 controls and 15 studies) participated in this study. 73% of children their age less than 6 month and 26% above the 6 month, the boys represents 33% and girls is about 66%, the 90% of children they birth in hospital while 10% were birth in their home , the type of labor among children was arranged between 90% of children as normal labor and

10% as cesarean section. Table 2 illustrated the comparison between active wrist extension improvement within the study and control groups before and after treatment, using both Active movement scale and Gilbert Raimondi.

Moreover, Table 3 demonstrated that no significant difference found between the groups before start the treatment, while significant difference found after treatment.

4. DISCUSSION

Several studies reported that about 95.7% of obstetrical brachial plexus palsies do resolve spontaneously, with 92% of the recovery taking place during the first 3 months [4]. Moreover, recovery is highly depending on the severity of neural damage. Regardless of higher spontaneous recovery rates, contractures and deformities may occur hastily, so it's not advisable to wait for spontaneous recovery, as limitation of motion and deformity may persist [4,30]. Such persistent residual deficits may include progressive bony deformities, muscle atrophy, joint contractures, possible impaired growth of limb, weakness of the shoulder girdle, and “Erb’s Engram” (flexion of the elbow accompanied by abduction of shoulder) [31].

Table 2. Comparison between the pre and post treatment in both groups

Assessment scale	Group		Mean ± Standard deviation	Mean difference	Z	P value
Active movement scale	Control	Pre treatment	2.13±1.55	1	-3.217	0.01*
		Post treatment	3.13±1.64			
	Study	Pre treatment	1.33±1.29	3.53	-3.499	0.01*
		Post treatment	5.06±1.9			
Gilbert-Raimondi	Control	Pre treatment	2.53±1.50	-0.9	-3.357	0.01*
		Post treatment	3.40±1.95			
	Study	Pre treatment	1.53±1.03	2.9	-3.457	0.01*
		Post treatment	4.40±1.40			

Z: Wilcoxin signed-ranks test *: Significant at 0.01 level of probability

Table 3. Comparison between the groups

Assessment scale	Both Groups	Z	P value
Active movement scale	Before treatment	-1.44	0.149
	After treatment	-2.77	0.006*
Gilbert-Raimondi	Before treatment	-1.9	0.07
	After treatment	-2.25	0.024

Z: Wilcoxin signed-ranks test *: Significant at 0.01 level of probability

In the current study, 30 children with Erb's palsy were divided to control and study groups, both received 15 sessions of physical therapy program; while children in study group received Kinesio-tape for wrist extension muscle. Two groups demonstrated improvement in wrist extension when comparing the pre and post treatment results within each group. Moreover; significant difference was recorded when comparing the post treatment results of both groups in favor of study group.

Several studies approved the essential role of physical therapy in minimize the occurrence of secondary and tertiary deformities [3], which is confirmed by the post- treatment results in this study which revealed significant improvement in the variables of the both groups. This improvement can be explained by process known as facilitation, where exercises increase the pre-synaptic calcium concentration, which transiently facilitates release of acetylcholine, hence increases the compound muscle action potential [32].

The application of Kinesio tape is still a new concept in the medical field, it use as additional to the therapeutic procedures. Several advantages of Kinesio tape were reported such as improve muscle strength, functional activities, proprioception, and positioning [21,26]. Kinesiotaping is a technique that allows a therapist to work on more functional activities through improved proper position. Our study provided significant effect of applying kinesiotaping over wrist extensor muscles jointly with a physical therapy program in children recovering from Erb's palsy. The technique by which the tape was applied (from origin to insertion) was chosen to assist muscle contraction, thus facilitating and improving its strength [17,18,33].

The results of the current study are further supported by ElKhatib et al. [29] who investigated the effect of kinesiotaping over the deltoid and the forearm in children recovering from Erb's palsy, they involved 30 children with Erb's palsy for a period of 3 months that revealed a significant improvement in favor of kinesiotaping group and the highly recommended and supported the introduction of kinesiotaping an adjunct to the treatment program of Erb's palsied children. Furthermore, Walsh et al. [34] reported 2-year-old female diagnosed with neonatal brachial plexus injury, she treated with kinesio tape and exercise that resulted in a

significant improvement in the functional, muscular, and boney changes of her upper extremity, and thus avoidance of surgical intervention. Similar study on the application of Kinesio Taping after facial nerve reconstruction showed improvement in face symmetry, and tongue muscles movements [35].

Furthermore kinesiotape reported to be beneficial in patients with myelomeningocele and it was verified to be used clinically in children with poor sitting balance, weak body muscles and balance problems on body muscles [36].

The current study had some limitations including: the irregular attendance of the subjects due to illness or vaccinations as a consequence to their young age. The small sample size of participating Erb's children; this resulted in narrowing the sample spectrum, and reduced the study generalizability. In addition, we did not measure EMG due to the unavailability of the equipment at the time of study.

5. CONCLUSION

In our 30 children with Erb's palsy, Kinesiotape was used in addition to selected physical therapy program found to be beneficial therapeutic technique to improve wrist extension range of motion and functional activities than using a therapy program alone.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Lindqvist PG, et al. Identification of pregnancies at increased risk of brachial plexus birth palsy—the construction of a weighted risk score. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2014; 27(3):252-256.
2. Coroneos CJ, et al. Obstetrical brachial plexus injury: Burden in a publicly funded, universal healthcare system. *Journal of Neurosurgery: Pediatrics*. 2016;17(2):222-229.
3. Dunham EA. Obstetrical brachial plexus palsy. *Orthopaedic Nursing*. 2003;22(2): 106-116.
4. Malessy MJ, Pondaag W. Obstetric brachial plexus injuries. *Neurosurgery Clinics of North America*. 2009;20(1):1-14.

5. Pollack RN, et al. Obstetrical brachial palsy: pathogenesis, risk factors, and prevention. *Clinical Obstetrics and Gynecology*. 2000;43(2):236-246.
6. Pondaag W, et al. Natural history of obstetric brachial plexus palsy: A systematic review. *Developmental Medicine & Child Neurology*. 2004;46(2): 138-144.
7. Srilakshmi D, Chaganti S. A holistic approach to the management of Erb's palsy. *J Ayurveda Integr Med*. 2013;4(4): 237-40.
8. ElKhatib RS, et al. Kinesio arm taping as prophylaxis against the development of Erb's Engram. *Journal of Advanced Research*. 2013;4(6):485-491.
9. Louis D, Sundaram V, Samujh R. An unusual case of Erb's palsy in a neonate: A case report. *J Child Neurol*. 2010; 25(10):1261-1264.
10. Weizsaecker K, Deaver J, Cohen W. Labour characteristics and neonatal Erb's palsy. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2007;114(8): 1003-1009.
11. Gregory J, et al. The anatomy, investigations and management of adult brachial plexus injuries. *Orthopaedics and Trauma*. 2009;23(6):420-432.
12. Nath RK, Karicherla P, Mahmooduddin F. Shoulder function and anatomy in complete obstetric brachial plexus palsy: Long-term improvement after triangle tilt surgery. *Child's Nervous System*. 2010; 26(8):1009-1019.
13. Socolovsky M, et al. Obstetric brachial plexus palsy: Reviewing the literature comparing the results of primary versus secondary surgery. *Childs Nerv Syst*. 2016;32(3):415-25.
14. Halseth T, et al. The effects of Kinesio Taping on proprioception at the ankle. *J Sports Sci Med*. 2004;3(1):1-7.
15. Kase K, Martin P, Yasukawa A. *Kinesio Taping in Pediatrics*. Tokyo, Kinesio USA, LLC; 2006.
16. Renner CM. *Kinesio tape and its effects on internal and external range of motion of the shoulder _ A Thesis Presented to Indiana State University*; 2012.
17. Thelen MD, Dauber JA, Stoneman PD. The clinical efficacy of kinesio tape for shoulder pain: A randomized, double-blinded, clinical trial. *Journal of Orthopaedic & Sports Physical Therapy*. 2008;38(7):389-395.
18. Yoshida A, Kahanov L. The effect of Kinesio Taping on lower trunk range of motions. *Research in Sports Medicine*. 2007;15(2):103-112.
19. Hsu Y-H, et al. The effects of taping on scapular kinematics and muscle performance in baseball players with shoulder impingement syndrome. *Journal of Electromyography and Kinesiology*. 2009;19(6):1092-1099.
20. Ahmed H, Iqbal A, Shaphe A. Role of Kinesio Taping in Trunk Stability in patient with chronic low back pain. *Indian Journal of Physiotherapy and Occupational Therapy-An International Journal*. 2016; 10(1):178-184.
21. Simon J, Garcia W, Docherty CL. The effect of kinesio tape on force sense in people with functional ankle instability. *Clinical Journal of Sport Medicine*. 2014; 24(4):289-294.
22. Lim ECW, Tay MGX. Kinesio Taping in musculoskeletal pain and disability that lasts for more than 4 weeks: Is it time to peel off the tape and throw it out with the sweat? A systematic review with meta-analysis focused on pain and also methods of tape application. *Br J Sports Med*. 2015: p. bjsports-2014-094151.
23. Williams S, et al. Kinesio Taping in treatment and prevention of sports injuries. *Sports Medicine*. 2012;42(2):153-164.
24. Sadeghi Moghaddam R, et al. Investigating the effects of wrist Kinesio Taping on hand function of children with spastic diplegic cerebral palsy. *Journal of Modern Rehabilitation*. 2012;6(1):26-31.
25. Keklicek H, Uygur F, Yakut Y. Effects of taping the hand in children with cerebral palsy. *Journal of Hand Therapy*. 2015; 28(1):27-33.
26. da Costa CS, et al. Pilot study: Investigating the effects of Kinesio Taping(R) on functional activities in children with cerebral palsy. *Dev Neurorehabil*. 2013;16(2):121-8.
27. Curtis C, et al. The active movement scale: An evaluative tool for infants with obstetrical brachial plexus palsy. *The Journal of Hand Surgery*. 2002;27(3): 470-1.
28. Ruchelsman DE, et al. Brachial plexus birth palsy: An overview of early treatment considerations. *Bull NYU Hosp Jt Dis*. 2009;67(1):83-9.
29. ElKhatib RS, et al. Kinesio arm taping as prophylaxis against the development of

- Erb's Engram. J Adv Res. 2013;4(6):485-91.
30. Nath RK, Karicherla P, Mahmoududdin F. Shoulder function and anatomy in complete obstetric brachial plexus palsy: Longterm improvement after triangle tilt surgery. Childs Nerv Syst. 2010;26:1009-19.
31. Guha DK. Guha's neonatology: Principles and practice. 3rd ed. Jaypee Brothers Publishers. 2005;1.
32. Sirven JI, Malamut BL. Clinical neurology of the older adult. 2nd ed, ed. L.W.a. Wilkins; 2008.
33. Fu TC, et al. Effect of Kinesio Taping on muscle strength in athletes-a pilot study. J Sci Med Sport. 2008;11(2):198-201.
34. Walsh SF. Treatment of a brachial plexus injury using kinesiotape and exercise. Physiother Theory Pract. 2010;26(7):490-496.
35. Hałas I, Senderek T, Krupa L. The use of Kinesio Taping in improvement of face mobility in patient after facial nerve reconstruction. Fizjo Pol. 2005;5(2):272-276.
36. Simsek TT, et al. The effects of Kinesio Taping on sitting posture and functional independence in children with myelomeningocele: report of four cases/" Kinesio Tape" bantlama yonteminin miyelomeningoselli cocuklarda oturma sekli ve islevsel bagimsizlik uzerine etkisi: dort olgu sunumu. Turkish Pediatrics Archive. 2011;177-181.

© 2016 Kamal-Eldeen et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:

<http://sciencedomain.org/review-history/16065>