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The Influence of Kinesio Taping, Abduction Brace and Physio Ball Against Muscle Length of Hip Joint Through Change of Spasticity Levels in Children with Cerebral Palsy

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Abstract

Children with spastic cerebral palsy diplegi experience increased tone in several muscles, one of which is the hip joint adductor muscle. As a result, the legs experience stiffness and decrease extensibility of the adductor muscle and instability of the spine. The purpose of this research is to know the intervention to prevent or reduce contractures and maximize the length of the muscles carried out by providing a mechanical stimulus to induce muscle tissue. By applying a technique to the use of a device becomes the most important modality in pediatric rehabilitation. The common modalities used is kinesio taping, abduction brace and physio ball. The method used is a pre-experimental design. Respondents consisted of 30 children with spastic-type cerebral palsy aged 2-18 years (boys 14 people, gir-ls 16 people) and received kinesio taping, abduction brace and physio ball. All children were evaluated using the Ashworth scale and manual goniometer, before and after 6 times interventions. The results showed the level of spasticity at the pretest (median 3) and posttest (median 2) showed a noticeable difference from the decrease in the value of ashworth (p = 0.002). The length of the adductor muscles of both limbs at the pretest (7.358 ± 19.00 and 8.077 ± 18.67) and posttest (10.350 ± 30.13 and 10.620 ± 30.07). The range of motion hip abduction also showed an increase (p = 0,000). Significant negative correlation results were also obtained between the level of spasticity with adductor muscle length (r = 0.866; p = 0,000).

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This study shows that the combination of kinesio taping and abduction brace and physio ball can increase the length of the hip adductor muscle through decreasing muscle tone, stability between the spine in spastic-type cerebral palsy children.

Keywords: Kinesio Taping; Abduction Brace dan Physio Ball pada CP.

1. Introduction

Cerebral palsy is a disorder or damage to the non-progressive brain that occurs in the process of growth and development [1]. Cerebral palsy (CP) refers to a number of neurological abnormalities that are seen in infants due to developing brain lesions [2]. As a result of lesions that occur in various parts of the brain, the resulting clinical manifestations have their own characteristics. Based on these manifestations CP is classified according to types such as spastic, diskinetic, or ataxic type and based on the body topography that has CP disorders classified as hemiplegi, diplegi, to quadriplegi [3]. A survey conducted by surveillance of cerebral palsy in 10 countries in Europe showed 2 per 1000 child births were born with CP. The most common type of CP is bilateral spastic (54%) followed by 31% unilateral spastic. A total of 6.5% are classified in diskinetic CP and 4.3% atactic types. The prevalence of children aged 24-59 months who experience a disability due to CP is around 0.09% in 2010 and 2013 [4]. A study conducted at a Children's Hospital Polyclinic in Central Java province showed CP was first ranked of 10 diagnoses made in children [5]. Several studies have shown the use of kinesio taping can improve the ability to sit, stand, walk and balance in spastic CP children [6]. Whereas abduction brace can increase the range of hip motion in children CP adductor hip muscle contracture [7]. Orthosis such as rigid abduction brace can be an option in preventing deformities such as contractures in adductor muscles [8]. Abduction brace makes the muscle in an elongated position and gives a strectching effect on the adductor muscle. Giving Physio Balls to muscles will increase extensibility and mechanically increase muscle length [9]. The results of observations made in 2014 showed that for the last 3 years, 138 CP children had received Physiotherapy services at YPAC, SLB Parangtambung and Amel Center Makassar [10]. Based on primary data at the YPAC Makassar Physiotherapy clinic in 2017, 68 children of various ages receive services with a CP diagnosis. As many as 72% of CP patients have spastic type and 61% of them are spastic diplegi. From various studies conducted in various countries, the average bilateral type of CP includes spastic diplegi. In providing interventions for CP children, the physiotherapist must look at what side is currently needed to establish and prevent deformity in the child. It should be noted that the disturbance that occurs in CP children due to the central nervous system has problems interpreting the results of sensory input. As a result of abnormalities in the upper motor neurons it produces spasticity (excessive muscle tone) in the adductor muscle which if not corrected can cause contracture deformity so that the length of the adductor muscle becomes no longer elastic. Abduction brace can prevent and reduce contracture in adductor muscle while KT can provide sensory input related to muscle function so that sensory information related to muscle length from the use of abduction brace is expected to stimulate suprasinal with the right muscle length information and can reduce hypertonus.

2. Materials and Methods

2.1. Description of the Study Area

This research was conducted at YPAC Makassar for six months, starting in Mei- November 2017 by selecting 30 children with cerebral palsy. Data is processed and analyzed based on research objectives. The analysis results were presented using table equipped with table description.

2.2. Population and Sample

The population in this study were 68 patients with spastic diplegi CP who received physiotherapy services at YPAC Makassar clinic. Samples of 30 children with cerebral palsy were taken by purposive sampling technique. The samples are determined based on inclusion and exclusion criteria.

2.3. Inclusion Criteria

Spastic diplegi CP patients who receive physiotherapy services, are willing to be the subject of research and sign an informed concern (represented by parents), take measurements or research, can use an abduction brace and do not experience hip dislocation, aged 2-18 years.

2.4. Exclusion Criteria

The exclusion criteria was do not regularly come to the YPAC Makassar Physiotherapy clinic, have skin that is sensitive to adhesive taping, suffer from skin diseases in the leg area.

2.5. Collecting Data and Procedure Intervention

The researcher makes a letter of approval, and the patients (or their parents) must sign the contents of the report that the respondent is willing to be a sample of this research until the end of the research. Data collection by researcher by measuring spasticity level using ashworth scale.

2.6. Data Analysis

The data obtained in this study are primary data from the measurement of hip adductor muscle length in the study sample group. The data obtained were analyzed computerized using a comparative test in the form of a paired t test or Wilcoxon.

2.7. Ethical consideration and clearance

Ethical approval for this research was obtained from the Ethics Committee, Health Polytechnic of Makassar, Indonesia.

3. Results

the influence of kinesio taping, abduction brace and physio ball against muscle length of hip joint through change of spasticity levels in children with cerebral palsy using subjects were cerebral palsy aged 2-18 years who meet the inclusion criteria in this study.

Table 1: Distribution of cerebral palsy according to sex

Sex	Frequency	Persentage
Male	14	46,67%
Female	16	53,33%
Total	30	100%

Table 1 shows that sex distribution of cerebral palsy at YPAC Makassar consist of 14 subjects (46,67%) are male, and 16 subjects (53,33%) are female.

Table 2: Distribution of cerebral palsy according to age

Age	Frequency	Persentage
2-4 years	8	26,67
4-6 years	8	26,67
6- 12 years	10	33,33
12 – 18 years	4	13,33
Total	30	100

Table 2 shows respondents aged 6-12 years at 33.33% while the aged 12-18 years only 13.33%. The age category in the above table is adapted from the age classification system according to the gross motor function classification system (GMFCM).

Table 3: Distribution of cerebral palsy according to spasticity level

Level	**Ashworth Scale**	**Frequency**			
		Pretest	Persentage	Postest	Persentage
Normal	0	0	0%	0	0%
Average	1,2	8	26,67%	22	73,33%
High	3,4	22	73,33%	8	26,67%
Total (n)	5	30	100%	30	100%

The method used is a pre-experimental design. Respondents consisted of 30 spastic-type cerebral palsy children aged 2-18 years (boys 14 people, girls 16 people) and received kinesio taping, abduction brace and physio ball. All children were evaluated using the Ashworth scale and manual goniometer, before and after 6 interventions.

Table 4: Distribution of cerebral palsy according to muscle length of adductor

Level	**Range of abduction**	**Frequency**							
		Pretest				**Posttest**			
		Dextra	**%**	**Sinistra**	**%**	**Dextra**	**%**	**Sinistra**	**%**
Poor	0-15	14	46,67	14	46,67	4	13,33	4	13,33
Good	16-30	14	46,67	12	40	14	46,67	14	46,67
Very good	>31	2	6,66	4	13,33	12	40	12	40
Jumlah(n)		30	100	30	100	30	100	30	100

Table 4 shows the frequency of hip adductor muscle length with measurements of abduction motion area measured using a goniometer before and after the intervention. Before the intervention only 2 (6.66%) respondents showed very good abduction area for the limbs of the dextra and for the limbs of sinitra as many as 4 (13.33) respondents, whereas after the intervention 12 (40%) respondents showed a very good abduction area on dextra and sinistra limbs. Measurement of respondent's muscle tone showed a significant decrease, from medium value 3 down to 2, but there were 8 respondents whose muscle tone value was still in the high category. From the results of the questionnaire given to parents it was found that there were respondents who were accompanied by seizures, this was often found in CP children.

Table 5: Analysis of the spasticity level of children with spastic diplegi CP

Spasticity level	**Spastic Cerebral Palsy Diplegi (n=30)**				
	Min	Med	Max	Sig.	P
Pretest	2	3	4	0,003	0,002
Posttest	2	2	4	0,016	

Min = minimum value, Med = Median value, Max = maximum value. Sig. = Shapiro-Wilk normality test probability; p = probability of Wilcoxon test results

Table 5 shows the value of the medium spasticity level before and after the intervention has decreased from 3 to 2. The minimum value before the intervention also decreased from before with the value of 2 down to 1. However, the maximum value obtained both before and after the intervention showed no change, the number indicated remains 4.

Table 6: Analysis of muscle adductor length of children with spastic diplegi CP

Muscle adductor length		**Cerebral Palsy Spastik Diplegi (n=30)**			
		Mean	SD	Sig.	P
Right	Pretest	19,00	7,358	0,299	0,000
	Postest	30,13	10,350	0,0670	
Left	Pretest	18,67	8,077	0,302	0,000
	Postest	30,07	10,620	0,131	

Min = minimum value, Med = Median value, Max = maximum value. Sig. = Shapiro-Wilk normality test probability; p = probability of paired sample t-test results

Table 6 shows the mean of hip adductors muscle length right and left limb before and after intervention increased from 19.00 to 30.13. The Shapiro-Wilk normality test shows the distribution of pretest and posttest data on both limbs that are normally distributed which can be seen in the table where all significance or sig values are more than 0.05 ($p > 0.05$, then the data are normally distributed). All data distribution is normally distributed then the hypothesis test is performed with the parametric test, paired sample t-test.

Table 7: Correlation of spasticity levels with adductor muscle length

	Sig	p	r
Posttest spasticity level Posttest right adductor muscle length	0,016 0,131	0,000	-0,866
Posttest spasticity level Posttest left adductor muscle length	0,016 0,670	0,000	-0,855

Sig. = Shapiro Wilk normality test probability; p = probability of the Spearman test results; r = Spearman Rho correlation value.

Table 7 shows the correlation between spasticity level and muscle length after the intervention. From the above results obtained p = 0,000 which indicates there is a correlation between the two variables. Spearman correlation value between the level of spastistas with dextra adductor is 0.866 and for the adductor sinistra is 0.855. Both correlation values show a negative correlation (there is one variable that increases and the other decreases) and a p value close to -1 which indicates a very strong correlation.

4. Discussion

This study was conducted on 30 respondents at Physiotherapy clinic of YPAC Makassar which consisted of 53.33% female and 46.67% male. The female-dominated respondents in this study were almost the same as the study conducted by Dwi Rustyanto in spastic CP children in the same place where the frequency of female respondents was 55% while 45% were male [7]. While the case-control study on cerebral palsy children who do Karla Sahabuddin shows the dominance boys were 60 children and 40 girls [10]. All respondents aged 2-18 years. As many as 33.33% of respondents aged 6-12 years. This is in line with research conducted by Dwi Rustyanto (2010) which shows that the most vulnerable respondents aged 6-12 years are 7 children (35%). In this study respondents aged 12-18 years had the smallest percentage of 13.33%. The above shows that the visit of CP children in Makassar YPAC clinic is dominated by spastic CP children who are 6-12 years old and are female. The measurement result of respondents muscle tone showed a significant decrease, medium value 3 down to 2, but there were 4 respondents whose muscle tone value was still in the high category. From the results of the questionnaire given to parents found that there are respondents who are accompanied by seizures, this is often found in children with CP. The immature brain is very susceptible to seizures as reflected in the high incidence of seizures in neonates and infants. Seizures occur as a result of abnormal electrical activity in the central nervous system which causes involuntary contractions of muscles which causes muscle tone to increase very high [3]. From the 4 respondents it was also found that when treated they gave rise to a protective reaction by crying. Crying is a reaction when a child experiences distress or feels in a dangerous condition. Children with spasticity show signs of hypersensitivity. Children can be very afraid of moving, becoming stiff, and sad. Muscle tone can increase if there is a slight movement sensation [11]. Research conducted by Saputry to look at the cooperative level of children in dental care concluded that spastic-type cerebral palsy children had the highest anxiety level compared to ataxic and athetoid types. Anxiety and fear that occur in children can affect

the attitudes and behaviors shown to others [12]. The department of development medicine, the royal children's hospital said that during development, some children with cerebral palsy can develop behaviors that are disruptive, unfriendly or difficult to handle. They can also be frustrated because they are unable to move or communicate. Emotional stress, when a child feels he is trying to achieve his desires, they may react stubbornly or refuse to cooperate. The state of expression of children depends on many variables, including temperament, the level of development of the nature and duration of stress, past experience, and the ability of families to cope and adjust [13]. The results of this study also show the average level of spasticity of respondents before and after the intervention has decreased, this is contrary to the changes that occur in muscle length. All respondents showed a significant increase in muscle length after 6 treatments. The mean length of the right leg muscle before intervention was 19.00 and after the intervention increased to 30.13, while for the left leg before intervention the length of the muscle was 18.67 and after the intervention increased to 30.07. These results show the spasticity level variable has decreased while the muscle length variable has increased. This is in accordance with the Spearman test which shows a negative correlation. From the correlation test, there was a strong correlation between the level of spasticity with the right and left adductor muscle length as seen from the results of the spearman correlation test of 0.866 and 0.855 with a value of p = 0,000, and the results of the comparative test with a value of p = 0.002 (p value of the spasticity level) and p = 0,000 (p value of muscle length) which shows a difference before and after the intervention. The above shows that there is an effect of kinesio taping and abduction brace on muscle length through a decrease in the level of spasticity. These results are in line with previous studies conducted by Hagglund and Wagner related to the correlation of spasticity levels with the degree of lower limb dorsiflexion in cerebral palsy children which shows children who have high ashworth values have decreased dorsiflexion degrees compared to those with low ashworth values [14]. Decrease in the level of spasticity and increase in the length of the adductor muscle in respondents obtained from the use of abduction brace and kinesio taping and physio ball for 6 times. This is in line with Dwi Rusyanto's research using abduction brace in spastic CP children and carried out for 12 weeks with an intensity of 30 minutes each use obtained adductor muscle contracture reduction marked by an increase in hip abduction joint distance (p = 0.001) [7]. Abduction Brace provides passive stretching which affects the decrease in muscle contractures. Passive stretching given from the use of an abduction brace stretches the muscles. When the muscle is stretched the muscle spindle records the change in the length of the muscle and sends that signal to the spinal cord so that with continuous use the muscle spindle experiences habituation of the new length [15]. Another study conducted by Ibrahim also used kinesio taping to see the ability to stand and walk in spastic type cerebral palsy children showed a significant improvement in both aspects as seen from the results of pre and post which increased (p = 0.05) [16]. In this study, kinesio taping was given to respondents with the facilitation method of abduction and knee lateral rotation facilitation methods (these two methods are also called hip lateral rotation facilitation methods) where the anchor tape is placed on the gluteus area (to facilitate the gluteus maximus and gluteus muscles medius which is the driving muscle of hip abduction) to the medial upper leg and the other anchor tape placed on the medial anterior lower leg, towards the diagonal posterior knee to the medial upper leg. Children with CP diplegi experience a tendency to hip adduction, flexion and internal rotation due to spasticity in adductor muscle, hip flexor, and calf muscle [8].

The use of kinesio taping in the gluteus muscle area is supported by previous studies conducted to see the effect

of kinesio taping on the ability of hip extension which shows greater hip extension results compared to the results of hip extensions that do not use kinesio taping ($p < 0.001$) [17]. Kinesio taping has a positive effect on the mechanoreceptors. Kinesio taping that is affixed to the muscle or joint area can increase muscle extensibility [6]. Kinesio taping has an effect on the neuromuscular response that occurs including an increase in proporeceptors in the leg muscles through cutaneous mechanoreceptors in the taping area, increased efficiency in the primary motor cortex, adaptation in the cerebellum and cortex of the association, and the precise contraction time between the agonist and antagonist muscles. The use of abduction brace and kinesio taping makes the nerve tissue deliver sensory stimuli to the central nervous system. An information or stimulus when it passes through a series of synapses on the neural network, in the future will be more able to transmit the same signal due to synapse receptors that are accustomed to receiving the same information, this process is called facilitation. Facilitation or change from synapse efficiency between two neural networks to the activation of synapses which have not been active underlie neuroplasticity in nerve tissue. Neuroplasticity is a term used to describe changes in neural network function, changes that occur from the molecular level, morphological, synapses, cortical, to functional [18]. Changes in the level of spasticity and muscle length in this study were obtained due to facilitation that occurred in the respondent, which was preceded by sensory impulses related to the supposed muscle length, then added the sensory effect of the mechanoreceptors on the skin related to the sense of position. As a result of routine information that is routinely given, the receptors in the muscles and skin have increased stimulation threshold values (NAR) or habituation due to new sensations. As we know that physiologically when muscles are stretched, contraction reflexes arise due to the stimulation of the muscle spindle, precisely the receptor sensory nerve fibers of type IA proprioreceptors. As a result of excitation in these receptors, the anterior spinal cord responds so that the motor nerve excites the muscle to contract. The anterior spinal cord is the part that plays a role in sending signals to regulate muscle tone. CP children have disturbed tone control due to CNS disorders, so that when the anterior spinal cord receives impulses, the response will be given too much and cause strong contractions [15]. Abduction brace and kinesio taping work together to provide the correct sensory sensations that change the NAR at the receptor, making the neural network facilitated, until neuroplasticity occurs which is marked by an increase in respondents. The incidence of neuroplasticity in each child is different because cognitive factors, sensory cell abilities, to the degree of damage to the nervous system affect it.

5. Limitation of The Study

The factors that influence length of the hip adductor muscle in this study are only kinesio taping, abduction brace, and physio ball, while there are many other factors that affect length of the hip adductor muscle such as nutrition, and exercise provided by parents.

6. Conclusions

The researcher concluded that there was an effect of combination of kinesio taping, abduction brace, and physio ball can increase the length of the hip adductor muscle through decreasing muscle tone, stability between the spine in spastic-type cerebral palsy children.

7. Abbreviations

CP: Cerebral Palsy.

8. Competing interest

The authors declare that they have no competing interest.

9. Recommendation

Based on the results of this study, it is recommended to use the combination of kinesio taping, abduction brace, and physio ball can increase the length of the hip adductor muscle through decreasing muscle tone, stability between the spine in spastic-type cerebral palsy children.

References

[1]. Sari, R.N., Penatalaksanaan Fisioterapi Pada Kasus Cerebral Palsy Spastic Diplegi Dengan Metode Neuro Developmental Treatment (NDT) Di Yayasan Pendidikan Anak Cacat Cabang Surakarta. 2013, Universitas Muhammadiyah Surakarta.

[2]. Behrman, R.E., R. Kliegman, and A. Arvin, Nelson Ilmu Kesehatan Anak. Ed. I. EGC: Jakarta, 2012.

[3]. Rudolph, K.S., L.C. Schmitt, and M.D. Lewek, Age-related changes in strength, joint laxity, and walking patterns: are they related to knee osteoarthritis? Physical therapy, 2007. 87(11): p. 1422-1432.

[4]. Kesehatan, K., Riset kesehatan dasar (Riskesdas) tahun 2013. Diambil dari http://www. depkes. go. id/resources/download/general/Hasil% 20Riskesdas, 2014. 202013.

[5]. Nugraheni, I. and L.N. Safitri, Faktor Presdisposing Keterlambatan Perkembangan Pada Anak Dengan Cerebral Palsy Di RSUD Dr. RM. Soedjarwadi Provinsi Jawa Tengah. Infokes Journal, 2015. 5(1).

[6]. ŞŞimşşek, T.T., et al., The effects of Kinesio® taping on sitting posture, functional independence and gross motor function in children with cerebral palsy. Disability and rehabilitation, 2011. 33(21-22): p. 2058-2063.

[7]. Rustyanto, D., Pengaruh Passive Streching Menggunakan Abduction Brace terhadapt Pengurangan Kontraktur Otot Adduktor Hip Anak Cerebral Palsy Tipe Spastik di YPAC Makassar. tidak dipublikasikan, 2010.

[8]. Alexander, M.A., Matthews, Dennis, Pediatric Rehabilitation Principles and Practice Fourth Edition. Demos Medical Publications United State of Amerika: , 2010.

[9]. Weppler, C.H. and S.P. Magnusson, Increasing muscle extensibility: a matter of increasing length or modifying sensation? Physical therapy, 2010. 90(3): p. 438-449.

[10]. Sahabuddin, K., Analisis Faktor Prenatal, Natal, dan Postnatal Kejadian Cerebral Palsy di Makassar Tahun 2014. Skripsi Tidak diterbitkan. Makassar: Fakultas Kedokteran Universitas Hasanuddin., 2014.

[11]. Hinchcliffe, A., Children with cerebral palsy: A manual for therapists, parents and community workers. 2007: SAGE Publications India.

[12]. Saputry, N., Hubungan Cerebral Palsy dengan Tingkat Kooperatif Anal dalam Perawatan Gigi dan Mulut. . Skripsi tidak diterbitkan. Fakultas Kedokteran Gigi Universitas Hasanuddin, 2015.

[13]. Behrman, R.E., R. Kliegman, and A. Arvin, Nelson Ilmu Kesehatan Anak. Ed. I. EGC: Jakarta, 2000.

[14]. Hägglund, G. and P. Wagner, Spasticity of the gastrosoleus muscle is related to the development of reduced passive dorsiflexion of the ankle in children with cerebral palsy: a registry analysis of 2,796 examinations in 355 children. Acta orthopaedica, 2011. 82(6): p. 744-748.

[15]. Hall, J.E., Guyton and Hall textbook of medical physiology e-Book. 2015: Elsevier Health Sciences.

[16]. Marwa Ibrahim, Role of Neuromuscular Taping on Standing and Walking Abilities in Children with Diplegia Cerebral Palsy. Internasional Journal of Development Research, 2015. 5(09): 5492-5495.

[17]. Kilbreath, S.L., et al., Gluteal taping improves hip extension during stance phase of walking following stroke. Australian Journal of Physiotherapy, 2006. 52(1): p. 53-56.

[18]. Ploughman, M., A review of brain neuroplasticity and implications for the physiotherapeutic management of stroke. Physiotherapy Canada, 2002. 54(3): p. 164-176.