Comparison of Hold Relax And Contract Relax Techniques in Improving ROM across Knee Joint in Children with Spastic Cerebral Palsy

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Abstract:

Background: Spastic cerebral palsy is upper motor neuron lesion in which permanent abnormality in the cerebral cortex of brain so there is not a cure for it. Physical therapy interventions are including Hold relax and Contract relax help to reduce the spasticity in hamstring in spastic cerebral palsy.

Objective: To compare the effects of hold relax and contract relax techniques on improving range of motion (ROM) across knee joint in children with spastic cerebral palsy.

Material and Method: A randomized control trial study was conducted on 20 patients suffering from spastic cerebral palsy at Physiotherapy Department of PSRD Lahore from 16 April to 16 august 2022. The patients were randomly allocated in two groups treated with conventional protocol Group A was treated with hold relax technique. Group B was treated with contract relax technique. The whole session was completed with 6 sets of exercises within 40-45 minutes. The evaluation was done through the Goniometer and Gross Motor Function Classification System (GMFCS) for the assessment of knee ranges and disability level. The data was analyzed through SPSS in which demographic data was presented in frequency (%), Mean ±S.d along with within and across the group difference described through the Wilcoxon and Mann Whitney test as data was not normally distributed with p-value <0.05.

Results: The result of study showed that Hold relax improves Right knee and Left knee ranges with p-value =0.038 and 0.052 respectively. Similarly; Contract Relax improves Right knee with *p-value* =0.004 and Left knee with p-value =0.005. Furthermore; inter-group comparison of Right knee results showed Hold relax was 7.95 while Contract Relax was 13.05 with *p-value* =0.048 and *d* = 0.052. While inter-group comparison of Left knee reported Hold relax were 8.85 while Contract Relax was 12.15 with *p-value* =0.007 and *d* = 0.018. This showed Hold relax was statistically significant in treating Knee ranges especially knee extension.

Conclusion: The study concluded that Hold relax and Contract relax both are effective in improving knee ranges especially knee extension. However; Hold relax is statistically significant in enhancing knee extension by reducing the tightness of affected knee hamstring muscles.

Index Terms: Contract relax technique, Hamstring flexibility, Hold relax technique, Spastic Cerebral palsy.

I. Introduction:

Cerebral palsy is the most common category of Neurodevelopmental Delay. Cerebral means relating to brain and palsy mean paralysis. Therefore, Cerebral palsy means brain disease causing paralysis. Cerebral palsy is some kind of upper motor neuron lesion [(1)]. The cerebral palsy is classified in to spastic syndrome, dyskinesia syndrome and ataxic syndrome according to the part of brain affected. Three main parts of our brain are cerebrum, cerebellum, and basal ganglia [(2)]. The clinical signs of spastic cerebral palsy are hyper-reflexia, clonus, hyper-tonicity, spasticity, weakness, tremor and positive pathological reflexes (Babinski sign)[(3)].

Patients with dyskinetic Cerebral palsy present with slow, involuntary and uncontrolled movements also known as dystonia .This type of cerebral palsy is characterized by random dance like rhythmic movements known as chorea [(4)]. Patients with Ataxic cerebral palsy have hypotonic flaccid muscles, dysdiadochokinesia (inability to perform rapid alternating muscle movements), dysmetria (inability to measure distance), wide based gait and they lose their fine motor skills like writing and typing [(5)].

Cerebral palsy is the result of permanent abnormality in different areas of brain so there is not a cure for it. However, we can treat the complications associated with cerebral palsy. The treatment of cerebral palsy is multidisciplinary approach [(6)]. The most used approach is pharmacological method in which oral medications including baclofen, diazepam, dantrolene and tizanidine were used. However; injections including intrathecal baclofen, and local injections of botulinum toxin, phenol, and alcohol are also preferred [(7)]. Additionally, Physical Therapy can help cerebral palsy patients in following way: by overcoming physical limitations, increasing range of joint motion, building and maintaining muscle tone, decreasing contractures and bone deformity [(8)]. According to the International PNF Association, Dr. Herman Kabat developed PNF stretching in the 1940s. PNF stretching may be the most effective stretching technique for increasing range of motion [(9)].

Hold relaxes technique focus on isometric contraction of either the agonist, antagonist or synergistic group of muscles. Contract-relax technique focus on isotonic contraction of either the agonist or antagonist group of muscles [(10)]. The rationale of this study was to find out the effective PNF treatment i.e comparative effects of hold relax and contract relax techniques for the improving knee ranges in the children with spastic cerebral palsy. This study also aimed to spread the awareness of these techniques among society suffering from this disability. This study also aimed to spread awareness among physiotherapists about the best treatment approach. Previously no studies have been done to compare these two PNF techniques so this study adds new evidence about these techniques.

II. Material and Methods:

The randomized control trial study conducted in the Physiotherapy department of the PSRD Lahore after getting the ethical permission from the research committee. In this study,

twenty patients were evaluated according to designed inclusion and exclusion criteria of study. A proper written and verbal consent of treatment protocol was taken from the parents or guardians of the Spastic cerebral palsy children. Participants included in the study were 3 to 10 years of age of both male and female gender fulfill GMFCS level II and III classification with bilateral Spasticity at Knee joint. Children other than spastic forms of cerebral palsy, with severe mental retardation, older than required age and diagnosed with any other medical especially cardiac and musculoskeletal pathologies were excluded.

After collecting the data, the participants were randomly divided into two groups i.e. Group A and Group B; as 10 individuals in each group for study of 6 months duration. **Group A** were treated with conventional treatment and hold relax technique. Whereas **Group B** were treated with conventional treatment and contract relax technique. After allocation; the data including demographic data i.e age, gender, medications and range of motions (ROM) was recorder. ROM of knee extension was assessed by using goniometer at the beginning of treatment and then at the end of treatment. The difference in the improvement and reduction in symptoms was noted and compared before and at the end of the treatment session with no drop out from the study.

Intervention protocol

Group A---Hold Relax Treatment: The treatment protocol was initiated with the application of Hot packs on both knees for a duration of 10 minutes [(11)]. After application of hot pack; passive stretching was applied on the restricted knee joint. The children was in supine lying position in which hamstrings were stretched by physical therapist for 45 seconds bilaterally for 5-6 times [(12)]. Additionally; Hold Relax was performed by therapist as the affected knee moved up to the end range of extension by applying resistance throughout the range. Resistance was applied to isometric contraction of hamstring for duration of 6 seconds. Knee joint then moved to the new position. These steps were repeated for 5 to 6 times [(13)].

Group B---Contract Relax Treatment: In Group B; The treatment protocol was initiated with the application of Hot packs on both knees for a duration of 10 minutes [(11)]. After application of hot pack; passive stretching was applied on the restricted knee joint. The children was in supine lying position in which hamstrings were stretched by physical therapist for 45 seconds bilaterally for 5-6 times [(12)]. Additionally; Contract Relax was performed by therapist as the restricted knee joint moved up to the end range of extension by applying resistance throughout the range. Patient was asked to strongly contract the hamstring muscle group isotonically while the therapist applied resistance to hamstring. Resistance was hold up to six seconds and then the joint was reposition into new range. These steps were repeated for 5 to 6 times [(14)].

Statistical analysis

The sample size was calculated by using G power program by the research center of Johar Institute of Professional studies, Lahore by using the effect size of the past studies. According to the past studies, the

estimated size was 20 with 95% confidence interval. The statistical analysis was done by the SPSS version 26. Wilcoxon test and Mann-Whitney tests were used to analyze results. Demographic data such as age, drug history and Gross Motor Function Classification System (GMFCS) were analyzed through descriptive statistics and shown by bar charts.

The normality of data was analyzed through Shapiro Wilk test that described data was not normally distributed as p-value < 0.05. The non-parametric tests were used for analyses of within and across the group analysis. Wilcoxon signed-rank test was used for within group analysis in both groups however; across the groups difference was analyzed by using Mann Whitney test having p-value <0.05.

Table I: Baseline Characteristics of participants of all groups:-

Variables		Hold relax	Contract Relax
Age		5.25±2.53	4.95±0.89
Drug History	Tab piracetam	5 (50%)	1 (10%)
	Calcium Supplements	3 (30%)	3 (30%)
	Spasm-free muscle relaxant	1 (10%)	___
	Iron 3 hydroxide polymaltose complex	1 (10%)	2 (20%)
	Tab vitacin, calcium supplements	___	1 (10%)
	Tab valium	___	2 (20%)
	Tab valium, calcium Supplements	___	1 (10%)
GMFCS	Walk with limitation	___	8 (80%)
	Walk using hand held mobility device	10 (100%)	2 (20%)

Figure I : Drug History of participants among groups:-

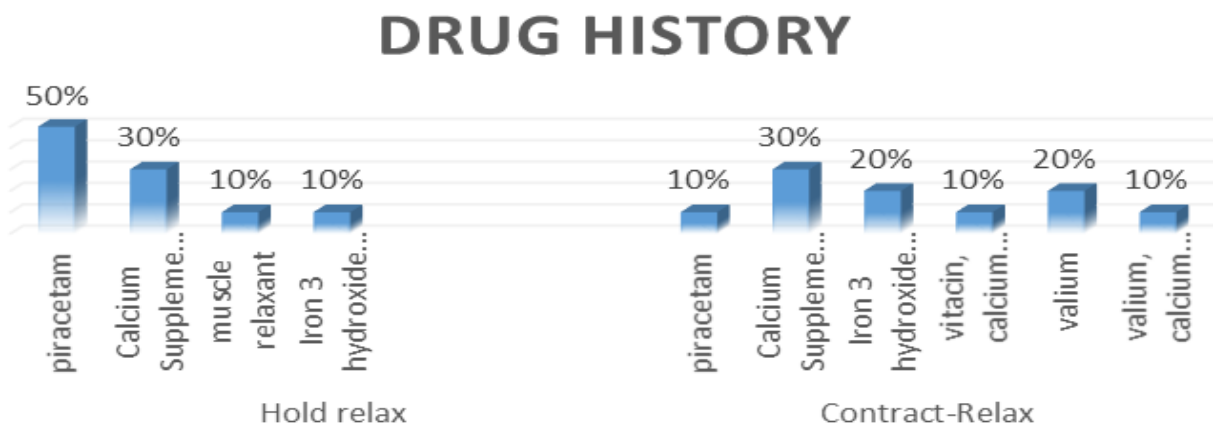

Table II: Within group analysis for Knee ROM of Hold Relax and Contract Relax:

Groups	Knee	IQR	Mean Ranks	Sum of Ranks	Z	Sig. (2-tailed)
Hold Relax	**Right Knee**	Pre -15 (-18.75 to -10)	5.00	40.00	-2.077	.038
		Post - 4.5 (-19 to -3.0)				
	Left Knee	Pre -19 (-21.25 to – 9.75)	5.50	44.00	-1.683	.052
		Post -8.0 (-18.50 to -4.2)				
Contract Relax	**Right Knee**	Pre -10 (-17.5 to -10)	5.50	55.00	-2.842	.004
		Post -2.0 (-7.5 to -2.0)				
	Left Knee	Pre -13.5 (-23.5 to -2.0)	5.50	55.00	-2.807	.005
		Post -2.5 (-9.0 to -2.0)				

Table III: Comparison of Right and Left Knee Post- ROM among Hold Relax and Contract Relax:

Knee	Group	IQR	Mean Ranks	Man Whitney U	Wilcoxon W	Z	Sig (2-tailed)
Right Knee	**Hold Relax**	- 4.5 (-19 to -3.0)	7.95	24.50	79.50	-1.974	*P*= 0.048 d = 0.052
	Contract Relax	-2.0 (-7.5 to -2.0)	13.05				
Left Knee	**Hold Relax**	-8.0 (-18.50 to -4.2)	8.85	33.50	88.50	-1.263	*P*= 0.007 d = 0.018
	Contract Relax	-2.5 (-9.0 to -2.0)	12.15				

III. Results:

The results of the data analysis of current study were describe in the tabulated and graphical form. The demographic data of 20 patients were describe in ***Table I***. The mean age of Hold Relax group was 5.25±2.53 and the mean age of Contract relax group was 4.95±0.89. The *Table I* and *Figure I* described the detail information about the regular medication of CP children taken during the treatment session. The children in Hold relax group took medications including Tab. piracetam 5 (50%), Calcium

Supplements 3 (30%), Spasm-free muscle relaxant 1 (10%) and Iron 3 hydroxide polymaltose complex 1 (10%). Similarly, the Contract-relax group took medication including Tab. piracetam 1 (10%), Calcium Supplements 3 (30%), Iron 3 hydroxide polymaltose complex 2 (20%), Tab vitacin, calcium supplements 1 (10%), Tab valium 2 (20%) and Tab valium, calcium Supplements 1 (10%).

The ***Table I*** provide the information about the Gross Motor Functional Classification Scale (GMFCS) scoring among the participants of both groups. The scale showed that 0 (0%) participants of Hold Relax walk with limitations while 8 (80%) participants of Contract Relax had walk with limitations. However, 10 (100%) participants of Hold Relax walk using different mobility devices while only 2 (20%) of Contract Relax participants had ability to walk with some mobility devices.

The intra-group analysis of each group was described in ***Table II,*** analyzed through the Wilcoxon Signed rank test. The results showed that Hold relax group of Right knee had Mean Ranks of 5.00, pre IQR-15 (-18.75 to -10) and post IQR - 4.5 (-19 to -3.0), Z -2.077 with p-value =0.038. The Left knee had Mean Ranks of 5.5, pre IQR -19 (-21.25 to -9.75) and post IQR – 8.0 (-18.50 to -4.25), Z -1.683 with *p-value* =0.052 showed that Hold relax produce significant results in improving ranges of both Right and Left knee with *p-value* <0.05. The ***Table II*** reported the results of Contract Relax group in which Right knee had Mean Ranks of 5.50, pre IQR -10 (-17.5 to -10.00) and post IQR – 2.0 (-7.50 to -2.00), Z -2.842 with *p-value* =0.004. The Left knee had Mean Ranks of 5.50, pre IQR -13.50 (-23.50 to -2.00) and post IQR -2.50 (-9.00 to -2.00), Z -2.807 with p-value =0.005 showed that Contract relax produce significant results in improving range of Right knee and Left knee with *p-value* <0.05.

The inter-group analysis of Knee ranges improvement of both groups was describe in ***Table III*** conducted through Mann Whitney U tests. The Inter-Quartile range of post-Right knee of Hold Relax was - 4.5 (-19 to -3.0) while Contract Relax was -2.0 (-7.5 to -2.0). The Right knee results showed that the post- ROM Mean Ranks of Hold relax was 7.95 while Contract Relax was 13.05 with Man Whitney value of 24.50 and Wilcoxon value of 79.50, Z -1.974 with *p-value* =0.048 and *d* = 0.052. This confirmed that both techniques were effective in improving the ROM of right knee still Hold Relax produces remarkable results in increasing ROM of right knee. Similarly; the inter group analysis of Left knee reported the Inter-Quartile range of post-Left knee difference knee of Hold Relax was -8.0 (-18.50 to -4.2) while Contract Relax was -2.50 (-9.00 to -2.0). The results showed that the post- ROM Mean Ranks of Hold relax were 8.85 while Contract Relax was 12.15 with Man Whitney value of 33.50 and Wilcoxon value of 88.50, *Z* -1.263 with *p-value* =0.007 and *d* = 0.018.This concluded that there was no significant comparative results was observed between both groups.

IV. Discussion:

The recent study was conducted to determine the effectiveness between hold relax and contract relax in improving ROM across knee joint. The results showed the significant

improvement in all the outcome measures. Post treatment ROM showed significant improvement in knee extension between both groups. However, on comparison Hold relax exercises produce better results in increasing bilateral knee extension range significantly as compared to contract relax.

A comparative study conducted by Ahmed H et, al (2015) on the effect of hold relax, static stretching and conventional physical therapy effect on the hamstring muscles of the knee. The study concluded that hold relax is statistically significant in enhancing the range of knee joint by improving the flexibility of hamstring muscle. Hold relax cause the reduction in the tension of the contractile component of muscles. i.e hamstring muscles in the knee joint that helps in inducing relaxation at the knee joint [(15)]. Similarly, Gribble et, al (1999) reported that autogenic inhibition is the main concept in the reduction of tension in the hamstring muscles among spastic patients. Golgi Tendon Organ (GTO) detects the tension change in muscles. PNF especially hold relax and contract relax increase the tension in the antagonist group of the muscles that ultimately relax the affected muscles and increase the range of knee joints [(16)].

The results of the study of Dhabi et al support the outcome of our study. This study showed that conventional physical therapy and Proprioceptive neuromuscular facilitation stretching is more effective to improve Gait, Balance and Functional independence in spastic diplegic cerebral palsy. PNF increases the ROM by stimulating the proprioceptors thus increasing muscle length and the neuromuscular efficiency. Autogenic inhibition, reciprocal inhibition and stress relaxation are the probable physiological mechanism for increasing the ROM and strength. The results of PNF are the lengthening of the contracted structures, relaxation of the hypertonic muscles, initiating the movements, strengthening the weak muscles and improving the control of the pelvis. PNF stimulate nerve and muscles function by utilizing distinct helical form pattern which is based on functional components to aid reaction of motor system located in muscles and joints, and turn human movements into patterns for various uses such as exercise intervention. Improvement of balance ability might have resulted from facilitation of proprioceptive sense, leading to change in various supports leads to increase in stability of joints [(17)].

The study of Cayco et al provide evidence on the effects of hold-relax and contract-relax stretching (HR and CR) on hamstrings flexibility compared with no intervention and other stretching techniques. This study also support the outcome of our study by showing immediate effects of HR and CR on hamstrings flexibility in adults [(18)].The study of Shanmugam et, al (2020) showed improvement in the TCMS score after the application of pelvic PNF techniques on children with spastic diplegia. This study included 36 diplegic children irrespective of gender, age group between 8-15 years.. The intervention group received pelvic PNF along with the conventional therapy for 4 weeks. The control group received conventional physiotherapy in form of truncal exercises for 4 weeks [(19)]. The study supported current study results as it concluded PNF techniques including hold relax helps in reducing the

disability among spastic children and increase the trunk and limb control.

Limitation & Recommendations:

Firstly, The major limiting factor was smaller sample size. This is propose to conduct a significant larger sample size to determine better results. Additionally, this study targeted only hamstring group of muscles. This study did not consider functional improvement in children with spastic cerebral palsy. The other recommendation is to target other muscle groups including quadriceps strengthening, stretching of gastrocnemius and iliopsoas. Furthermore; the study did not find any long-term effects in the patients as how prolong the ranges of knees were maintained. Therefore; it is recommended to conduct study in which prolong effect of these therapeutic protocol can be assessed without any medication. Lastly, the other limitation was the usage of different muscle relaxants that played an important role in relaxing muscles that increase the ranges of knee. Therefore, a further study should be conduct either with the analyses of the recommended doses of medicine or with limited to minimal use of medicine to find out the better results of both techniques.

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V. Conclusion:

Cerebral palsy is the motor developmental disorder that includes the spastic state leads to the development of decreased inhibition of stretch reflexes with the development of contractures and restriction of joint ranges. Hold relax and Contract relax are the techniques that helped to increase the ranges of knee joint significantly. However; on comparison Hold Relax is more effective in increasing knee extension in both right and left knees up to their functional capacity.

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