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Compare the effects of Agonist versus Antagonist Contract Relax Techniques on Ankle Range of Motion and Functional Mobility in Spastic Cerebral Palsy Patients

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Author`s Contribution

[1] [2] Substantial contributions to the conception or design of the work for the acquisition, analysis or interpretation of data for the work, [3] [4] Drafting the work or reviewing it critically for important intellectual content, [6] Final approval of the version to be published, [1] [5] Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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A B S T R A C T

Background: Increase in range of motion of ankle and functional mobility is the most important long-term consideration for the conservative management of cerebral palsy patients.

Objective: To compare the effects of agonist contract versus antagonist contract-relax technique on ankle range of motion and functional mobility in the spastic cerebral palsy patients.

Methodology: It was randomized control trial. The target population was spastic diplegic CP patients of age 6-12 years with Mini Mental State Examination (MMSE) score >24, Gross Motor Function Classification System (GMFCS) score of 1-3, and Modified Ashword Scale (MAS) score of <2. Total number of participants were seventy-two (thirty-six in each group i-e agonist contract relax group and antagonist contract relax group. It was a single blinded study. The protocol of both groups was done three days per week for eight consecutive weeks and data was collected at baseline, 4th week and 8th week. The outcome measures were spasticity and functional mobility.

Results: Total sample size was 72. Out of which 42(58.3%) were male and 30(41.7%) were female. The mean of age was 9.36 in agonist group and 8.89 in antagonist CR group. The results showed no significant difference for any outcome in between group comparison (p-value >0.05), however, the within group results showed significant difference (p-value <0.05).

Conclusion: The study concluded that both techniques are effective for improving functional mobility and range of motion in cerebral palsy patients

Key words: Agonist Contract Relax Technique, Antagonist Contract Relax Technique, Cerebral Palsy, Functional Mobility, Spasticity.

Introduction

Cerebral palsy (CP) is a congenital developmental defect or it is non-progressive acquired damage to brain. It includes low weight at birth, asphyxia, preterm baby, hypoxic-ischemic encephalopathy and trauma infections along with intrauterine infections and malformations [1]. The prevalence rate is 2.0 to 3.5 per 1000 births. [2] The clinical symptoms includes dyskinesia with and without sensory deficit and mental deficits. Hypoxia to brain causes intracerebral hemorrhage, brain damage, abnormal brain development, and white matter damage. [3] Currently, cerebral palsy is reported to be the fifth leading

cause of disability, resulting in significant economic burdens and challenges for both families and individuals. It also ranks third in terms of the need for basic living support. [4]

The presence of gait abnormalities, abnormal muscle tone, delayed milestones, or posture are the basics of the diagnosis of cerebral palsy. In child cerebral palsy, the sign and symptoms are varying. Involuntary movements, lack of balance, abnormal tone, delayed milestones, difficulty with fine motor skills, rigidity, excessive drooling, difficulty in walking, etc. are the main movements and coordination problems associated with cerebral palsy .[5] However, some symptoms become more or less apparent with the growth of a child. Muscle rigidity and shortening can worsen if not treated properly. Motor control deficits are the hallmark of cerebral palsy that differs in presentation and distribution as well as severity across children.[6]

CP children are affected by functional and daily living activities. Spasticity is the most common disability. Contractures due to alterations in connective tissues, increase muscular rigidity, and loss of sarcomeres are caused by spasticity.[7] Increasing or maintaining contractive and connective tissue length is the basic care of cerebral palsy. [8] Segmental spinal neurophysiological abnormalities are linked to spasticity. Decrease facilitation, decrease presynaptic and reciprocal inhibition, and increase motor neuron excitability. [9] Passive resistance is used to measure muscle tone. People have tight gastrocnemius-soleus complexes with spastic and neurological impairment. Increased muscle tone inhibits vertical growth of muscles leading to permanent contractions and disability can be produced if adequate treatment of spasticity is not performed. [10]

Weakness contractures are constrained spastic cerebral palsy children. There is a loss of passive dorsiflexion and pathologically increased stiffness with equinus in the ankle of cerebral palsy children which is usually severely affected. [11] Neural meditations can be done influential altered muscle architecture also appears. In the case of the gastrocnemius, a lack of sarcomeres in series or increased intramuscular connective tissues increased in vivo sarcomere length, reduced muscle belly, and fascicle length may reduce its extensibility mechanically [12].

To allow cerebral palsy children to advance their limbs forward to take steps effectively and efficiently to accomplish this, cerebral palsy children must have an adequate range of motion that is not hindered by dystonia, spasticity, contractures, sufficient strength to maintain body weight support, and motor control abilities.[13] Stretching and increased joint excursion in many interventions is very popular but its effectiveness is debateable. Proprioceptive neuromuscular facilitation techniques are more appropriate to improve the range of motion as compared to static stretching. Contract relax techniques is the most common technique used in proprioceptive neuromuscular facilitation stretching. In a fully stretched position the isometric contractions is followed by contract relax stretching techniques which comprises of static stretching.[14] Another stretching technique comprises of a combination of static and active stretching is known as antagonist contract-relax (ACR) stretching i.e., voluntary contractions of antagonistic muscles in the fully stretched position .[15]

This study aimed to evaluate the efficacy of the agonist contract relaxes versus antagonist contract-relax technique on ankle range of motion and functional mobility in the spastic cerebral palsy patient. Effects of contract-relax and antagonist contract-relax muscle stretching are being observed in healthy populations and in athletes to improve range of motion, muscle strength, and spasticity. However, to the best of our knowledge, no study has compared the effects of these two stretching techniques for improving ankle joint range of motion, spasticity, and functional mobility in the spastic cerebral palsy population. This clinical trial would be a valuable addition to the interventions for spastic cerebral palsy rehabilitation.

Methodology

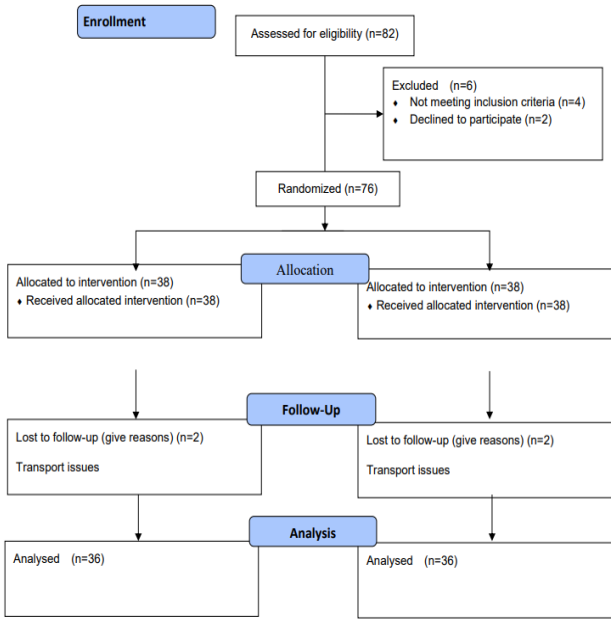
A randomized controlled trial was conducted on 72 spastic CP children at Pediatric physiotherapy department, Sikander medical complex, Gujranwala. Study was completed in 4 months (Feb 2023-June 2023) after the approval of synopsis from the institutional review board (REC-UOL-349-04-2023) and data was collected by probability sampling technique. After taking consent 72 participants were divided into two groups through sealed enclosed envelope method i.e. group A(Agonist contract relax) and group B (Antagonist contract relax).

Both groups were given routine physical therapy which includes electrotherapy, strength training of the lower limb, gait training, and occupational therapy. Patient was in the supine position. Initially, the trained physiotherapist kept the knee straight by placing a hand on it and passively dorsiflex the ankle to the maximum available range for 15 sec. In group A participants were instructed to perform maximal voluntary isometric contraction of plantar flexors for 5 sec in a stretched position where as in group B participants were instructed to perform maximal voluntary isometric contraction of dorsiflexors for 5 sec in a stretched position. After contraction the ankle was held in the same position for another 10 seconds by the physiotherapist by placing hand on it. After 30 seconds of hold, the trained physiotherapist returned the ankle to 0 degrees and

repeat the procedure without rest. The stretching was repeated four times for 2 minutes. The same procedure was repeated for soleus muscles, but in this stretch, the initial position of the knee was slightly flexed.

The range of motion of the calf muscles was recorded using a universal goniometer, placed on the lateral malleolus. The fixed arm was parallel to the fibular head and the moving arm was parallel to the metatarsal bone of the 5th toe. [15]

Treatment duration was three days per week for eight consecutive weeks. Data was collected at baseline, 4th week and at 8th week. Outcome measures were calculated using universal goniometer, Time up and go (TUG) test, 10-metre walk test, modified Ashworth scale and Gross Motor Function Classification System (GMFCS). The data was entered and analyzed using SPSS Version 24. The numerical data like age was presented in mean ±SD. Categorical Data like gender groups was presented in the form of frequency (Percentage). The data was not normally distributed, alternate non-parametric tests Mann Whitney U test and the Wilcoxon test was used for between-group and within-group comparisons; p-value < 0.05 considered significant.



CP children both male and female of age 6 to 12 years diagnosed by neurphysician having a score of >24 on modified MMSE for pediatric patient, [16] score of <2 on Modified Ashworth scale [17] and at levels 1, 2, and 3 of The Gross Motor Function Classification System (GMFCS) [18] were included in study whereas CP child having lower extremity orthopedic surgery within the past 1 year, having a history of tendon release or non-union fracture, intrathecal baclofen administration, uncontrolled epilepsy, inability to communicate due to severe intellectual impairment, ophthalmologic abnormalities, presence of musculoskeletal contracture in lower extremity joints, limitation in knee ROM of more than 10 degrees [17]or athetoid or mixed types of cerebral palsy were excluded from this study.

Results

Total sample size was 72. Out of which 42(58.3%) were male and 30(41.7%) were female. 18(50.0%) males were in agonist contract-relax (CR) group while 24(66.7%) were in antagonist CR group. 18(50.0%) females were in agonist CR group and 12(33.3%) were in antagonist contract-relax (CR) group.

The mean of age was 9.36 ± 1.930 in agonist group and 8.89±2.240 in antagonist CR group. Out of 72 participants, 49(68.05%) were underweight, 23(31.95%) were of normal weight.

Table I: Shows between group comparison using Mann Whitney U test.

Variable	Group	N	Mean Rank	Median	IQR	P-value
MMSE baseline	Agonist CR	36	37.01	25	2	0.825
	Antagonist CR	36	35.99			
	Total	72				
MMSE 4th week	Agonist CR	36	40.47	27	2	0.094
	Antagonist CR	36	32.53			
	Total	72				
MMSE 8th week	Agonist CR	36	35.42	29	1	0.635
	Antagonist CR	36	37.58			
	Total	72				
MAS baseline	Agonist CR	36	36.00	1	1	0.815
	Antagonist CR	36	37.00			
	Total	72				
MAS 4th week	Agonist CR	36	35.06	1	0	0.481
	Antagonist CR	36	37.94			
	Total	72				
MAS 8th week	Agonist CR	36	33.50	0.5	1	0.16
	Antagonist CR	36	39.50			
	Total	72				
GMFCS baseline	Agonist CR	36	40.00	3	1	0.079
	Antagonist CR	36	33.00			
	Total	72				
GMFCS 4th week	Agonist CR	36	33.00	2	0	0.044
	Antagonist CR	36	40.00			
	Total	72				
GMFCS 8th week	Agonist CR	36	34.00	2	1	0.209
	Antagonist CR	36	39.00			

	Total	72				
Ankle Dorsiflexion ROM baseline	Agonist CR	36	35.78	13	2	0.759
	Antagonist CR	36	37.22			
	Total	72				
Ankle Dorsiflexion ROM 4th week	Agonist CR	36	43.14	13	2	0.004
	Antagonist CR	36	29.86			
	Total	72				
Ankle Dorsiflexion ROM 8th week	Agonist CR	36	38.06	18	2.5	0.518
	Antagonist CR	36	34.94			
	Total	72				
Ankle planterflexion ROM baseline	Agonist CR	36	33.88	30	2	0.276
	Antagonist CR	36	39.13			
	Total	72				
Ankle planterflexion ROM 4thweek	Agonist CR	36	26.82	32	3	<0.001
	Antagonist CR	36	46.18			
	Total	72				
Ankle planterflexion ROM 8thweek	Agonist CR	36	24.33	39	3	<0.001
	Antagonist CR	36	48.67			
TUG baseline	Agonist CR	36	35.69	14.85	3	0.742
	Antagonist CR	36	37.31			
TUG 4th week	Agonist CR	36	32.75	8.5	1.875	0.125
	Antagonist CR	36	40.25			
TUG 8th week	Agonist CR	36	34.25	6.7	0.3	0.353
	Antagonist CR	36	38.75			
10m Walk test baseline	Agonist CR	36	34.36	0.5	0.1	0.362
	Antagonist CR	36	38.64			
10m Walk test 4th week	Agonist CR	36	34.24	0.6	0.0667	0.311
	Antagonist CR	36	38.76			
10m Walk test 8th week	Agonist CR	36	33.74	0.8571	0.25	0.233
	Antagonist CR	36	39.26			

There were 11(15.27%) patients of age 6 years, 10(13.89%) were of age 7 years, 7(9.73%) were of age 8 years, 11(15.27%) were of age 9 years, 9(12.5%) were of age 10 years, 12(16.67%) were of age 11 years, 12(16.67%) were of age 12 years. Kolmogorov-Smirnov test was used to check normality of data, P-value was <0.05 which shows non-normal distribution of data so non-parametric test was used.

Table II: within group comparison of variables using Wilcoxon sign rank test (Agonist CR group)

Within group comparison(Agonist CR)		Meanrank	Median	IQR	P-value
MMSE baseline	Negative ranks	17.00	25.00	2	<0.001
MMSE 4th week	Positive ranks	0.00	27.00	2	
MMSE baseline	Negative ranks	18.50	25.00	2	<0.001
MMSE 8th week	Positive ranks	0.00	29.00	1	
MAS baseline	Negative ranks	13.00	1.00	1	<0.001
MAS 4th week	Positive ranks	13.00	1.00	0	
MAS baseline	Negative ranks	0.00	1.00	1	<0.001
MAS 8th week	Positive ranks	15.00	0.00	1	
GMFCS baseline	Negative ranks	0.00	3.00	0	<0.001
GMFCS 4th week	Positive ranks	15.50	2.00	1	
GMFCS baseline	Negative ranks	0.00	3.00	0	<0.001
GMFCS 8th week	Positive ranks	17.5	2.00	1	
Ankle Dorsiflexion ROM baseline	Negative ranks	15.94	13.00	2	0.045
Ankle Dorsiflexion ROM 4th week	Positive ranks	11.90	14.00	1	
Ankle Dorsiflexion ROM baseline	Negative ranks	18.50	13.00	2	<0.001
Ankle Dorsiflexion ROM 8th week	Positive ranks	0.00	18.00	1	
Ankle planterflexion ROM baseline	Negative ranks	16.14	30.00	2	<0.001
Ankle planterflexion ROM 4th week	Positive ranks	12.30	32.00	2	
Ankle planterflexion ROM baseline	Negative ranks	18.50	30.00	2	<0.001
Ankle planterflexion ROM 8th week	Positive ranks	0.00	38.00	2	
TUG baseline	Negative ranks	0.00	14.700	3	<0.001
TUG 4th week	Positive ranks	18.50	8.400	0.375	
TUG baseline	Negative ranks	0.00	14.700	3	<0.001
TUG 8th week	Positive ranks	18.50	6.500	0.375	
10m walk test baseline	Negative ranks	14.50	0.5000	0.1385	<0.001
10m Walk test 4th week	Positive ranks	0.00	0.6000	0.0667	
10m walk test baseline	Negative ranks	18.50	0.5000	0.1385	<0.001
10m Walk test 8th week	Positive ranks	0.00	0.8571	0.25	

Table III: Within group comparison of variables using Wilcoxon sign rank test .(Antagonist CR group)					
Within group comparison (Antagonist CR)		**Meanrank**	**Median**	**IQR**	**P-value**
MMSE baseline	Negative ranks	16.73	25.00	2	<0.001
MMSE 4th week	Positive ranks	9.50	26.00	1.75	
MMSE baseline	Negative ranks	18.50	25.00	2	<0.001
MMSE 8th week	Positive ranks	0.00	29.00	1.75	
MAS baseline	Negative ranks	0.00	1.50	1	<0.001
MAS 4th week	Positive ranks	8.50	1.00	0.75	
MAS baseline	Negative ranks	0.00	1.50	1	<0.001
MAS 8th week	Positive ranks	13.50	1.00	1	
GMFCS baseline	Negative ranks	0.00	3.00	1	<0.001
GMFCS 4th week	Positive ranks	12.00	2.00	0	
GMFCS baseline	Negative ranks	0.00	3.00	1	<0.001
GMFCS 8th week	Positive ranks	11.00	2.00	0.75	
Ankle Dorsiflexion ROM baseline	Negative ranks	8.93	13.00	2	0.097
Ankle Dorsiflexion ROM 4th week	Positive ranks	11.35	13.00	2	
Ankle Dorsiflexion ROM baseline	Negative ranks	18.50	13.00	2	<0.001
Ankle Dorsiflexion ROM 8th week	Positive ranks	0.00	17.00	3	
Ankle planterflexion ROM baseline	Negative ranks	16.50	30.00	2	<0.001
Ankle planterflexion ROM 4th week	Positive ranks	0.00	33.50	3	
Ankle planterflexion ROM baseline	Negative ranks	18.50	30.00	2	<0.001
Ankle planterflexion ROM 8th week	Positive ranks	0.00	41.00	2.75	
TUG baseline	Negative ranks	0.00	15.500	3.225	<0.001
TUG 4th week	Positive ranks	18.50	8.500	0.475	
TUG baseline	Negative ranks	0.00	15.500	3.225	<0.001
TUG 8th week	Positive ranks	18.50	6.800	0.300	
10m walk test baseline	Negative ranks	14.50	0.5000	0.100	<0.001
10m Walk test 4th week	Positive ranks	0.00	0.6667	0.066	
10m walk test baseline	Negative ranks	18.50	0.5000	0.100	<0.001
10m Walk test 8th week	Positive ranks	0.00	0.8571	0.143	

Discussion

This study examined the effects of the agonist contract vs antagonist contract-relax technique on ankle range of motion and functional mobility in spastic cerebral palsy patients. The results showed statistically significant results for between-group analysis of ankle plantar flexion while other outcome measures showed no statistically significant difference. Within group analysis of both groups i-e agonist contract and antagonist contract relax showed statistically significant differences except for ankle dorsiflexion in 4th week.

A study conducted by Jose Afonso, aimed to assess the effects of stretching on ankle range of motion in patients. The analysis of 11 randomized controlled trials showed no significance difference in ROM between stretching and standard treatment interventions. [19] The results of this study is in accordance with our study where no significant results were found in between group analysis. However, in contrast to this study, our study showed significant results for ankle plantar flexion.

A study conducted by Pallavi Wajapey and Sarah Kapadi, focused on the use of functional electrical stimulation (FES) in combination with exercises has shown significant improvements in the case of spastic diplegia. FES stimulates agonist and antagonist muscles, leading to improve range of motion in lower extremities and reduced risk of fall in patients. Advancement suggests that that FES can be considered as an option in imrpoving range of motion because it plays beneficial role for patients in improving range of motion in children with cerebral palsy. [20] The results of this study is also in accordance with our study where stretching of agonist and antagonist muscle leads to improvement in range of motion and reducing risk of fall in CP child.

A study conducted by Faizan Fukaya, the study compared the effects of antagonist contract-relax stretching and contract-relax stretching on dorsiflexion range of motion (ROM), shear elastic modulus, and stretch tolerance. Both stretching methods significantly increased the range of motion and stretch tolerance, with no difference between the two groups. However, contract-relax stretching was more effective in decreasing

muscle stiffness compared to antagonist contract-relax stretching.[15] The results of this study is in accordance with our study where no significant results were found for between group analysis except for plantar flexion, however, results were significant for within group analysis.

Supriya S. Jadhav and Mandar Malawade proposed a study to examine the effect of ankle dorsiflexion on gait improvement in children with cerebral palsy. The results showed significant improvement in the ankle joint range of motion after the intervention. The findings suggest that facilitation dorsiflexion can benefit gait improvement in children with cerebral palsy. [21] The results are in contrast with current study. Current study reported improvement in ankle plantar flexion contrary to this study which reported improvement in ankle dorsiflexion.

Zahra Ahmadizadeh investigated the effects of whole-body vibrations combined with stretching exercises on the range of motion in the lower extremities of children with cerebral palsy. The experimental group, which received WBV with stretching, showed an increased range of motion and improved walking speed compared to the control group. The study suggests that WBV can be effective for the improvement of range of motion and gross motor function in children with cerebral palsy. [17] The results of this study is also in accordance with current study where techniques showed improvement in results.

Priyanka and colleagues investigated a study of two treatment approaches, Kinesio taping, and PNF techniques. The study showed the positive effects of these methods individually, but when both use adjuvant these methods show promising results in improving ankle dorsiflexion in children with cerebral palsy. After 12 weeks of intervention, the results show more improvement in the child's gross motor function and walking speed.[17] The results of this study are in contrast with current study. Current study showed improvement in ankle plantarflexion, however, the study by Prinyanka showed improvement in ankle dorsiflexion.

In the light of this discussion, the techniques showed improvement in outcome measures however, the results were not significant between group analysis.

Conclusion

The study concluded that both techniques are effective for improving functional mobility and range of motion in cerebral palsy patients.

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