OPEN ACCESS

ORIGINAL ARTICLE

Comparative Effects of High vs Low Frequency of Static Stretching on Hamstring Flexibility in Diplegic Cerebral Palsy Children

Ayesha Tabassum[1], Farjad Afzal [2]

[1] Senior Physiotherapist, Life House Foundation for Health and Education, Lahore
[2] Lecturer, Department of Physiotherapy, University of Sargodha, Sargodha

Keywords

Cerebral palsy; Range of Motion; Rehabilitation; Static Stretching

Author`s Contribution

[1]Acquisition of data, modified and finalized the manuscript, Formulation of the manuscript and drafting the work
[2]Analysis and interpretation of data, Revising the article critically for important intellectual content

Article Info.

Receive date: Aug 30, 2019
Acceptance date: June 08, 2019

Conflict of Interest: None
Funding Sources: None

Address of Correspondence

Ayesha Tabassum
draishapt79@gmail.com

Cite this article as: Tabassum A, Afzal F. Comparative Effects of High vs Low Frequency of Static Stretching on Hamstring Flexibility in Diplegic Cerebral Palsy Children. JRCRS. 2020; 8(1):41-46.
DOI: 10.5455/JRCRS.2020080109

ABSTRACT

Background: Cerebral Palsy the movement disorder due to brain injury results in muscles spasticity as well. Spasticity is well managed by stretching exercises. This study was a pre-post analysis of the effects of high frequency over sustained hamstring stretching of low frequency and how it decreases popliteal angle in diplegic cerebral palsy children.

Objectives: To analyze high frequency effects of static sustained stretching over low frequency on flexibility of hamstring muscle in children who are spastic diplegic and determine if the of stretching of high frequency would decrease the popliteal angle significantly.

Methodology: Quasi Experimental study was conducted with pre-post design in a school for special need children named Rising Sun Institute for Special Children, Mughal Pura Campus & Defense campus Lahore for four consecutive months that is December 4, 2015 to April 4, 2016.A group of 32 only male children of age range between 6 to 12 years were treated given a higher frequency of static sustained stretching i.e. 6 repetitions for 60 seconds hold for 5 days per week over the previously given dose of lower frequency of stretching exercise i.e. 3 repetitions for 30 seconds hold 5 days per week. The data for baseline measurements were taken before treating with the stretching of higher frequency and post-interventional data was taken after four months. SPSS version 22.0 was used for the analysis of data. The main outcome measure was popliteal angle and increase in hamstring flexibility.

Results: All the thirty one patients were male having mean age of 8.32±1.77 years. Statistical analysis concluded that high frequency of stretching of six repetitions for sixty seconds hold and five days per week had a significant effect over low-frequency regime of three repetitions for thirty seconds hold and five days per week on decreasing popliteal angle and increasing hamstring flexibility. P value < 0.05 was taken as having a significant effect on study.

Conclusion: This study showed that Sustained type of static stretching of high frequency more significantly effective as compared to low frequency in increasing hamstring flexibility and thus by decreasing Popliteal angle in spastic diplegic cerebral palsy children.

Introduction

"Cerebral palsy is known as a non-progressive movement and posture disorder due to an injury to the developing brain."[1] Cerebral palsy significantly restricts activities of daily living because the movement pattern is altered due to many reasons.[2] The diagnosis of Cerebral Palsy is always based upon a complete history of milestones and non -progressive pattern of abnormal motor development along with complete examination included but not limited to hypertonicity, increased reflexes , clonus "placing" the brain lesion.[3] Among the different types of cerebral palsy Spastic type is presented with muscles stiffness and limitations in joint range of

motion.[4] The Modified Ashworth scale is used as a simple measure of spasticity and it measures the resistance during passive stretching of soft-tissue.[5] Hamstring muscle is responsible for knee flexion and hip extension. In diplegic spastic cerebral palsy hamstring stiffness is more marked along with other lower limb muscles stiffness thus its flexibility is also compromised.[6]

Physical therapy plays a very important role in managing spasticity[7]. Popliteal angle measurement is the tool to measure hamstring flexibility.[8] A popliteal angle > 50 degrees in age groups ranging from 1-10 years indicates abnormal hamstring tightness.[9] Many studies have showed a decrease in popliteal angle with the correct selection of stretching program done with correct movement pattern. [10]

Passive sustained stretching regimes had always been widely used in managing spasticity by decreasing the motor neuron excitability and over activity of stretched muscles is minimized .[11]

Stretching effects depend upon the duration and frequency of the given stretch. Previous studies proved that the more prolong the stretch is the neuron excitability is decreased more resulting more reduction in tension of muscles and spasticity. In children with spasticity, the reflex arc control is lost by brain and this causes more spasticity and as a result muscles fibers along with sarcomere undergo many changes such as muscle tightness and decrease in muscles Range of Motion. Hyperactive stretch reflexes are reduced by static sustained stretchings.[12]

Many stretching exercises to increase muscle length have been previously used to manage spasticity in spastic diplegic Cerebral Palsy children. However, the static sustained stretching proves to be one of the safest and very common methods used to increase the muscle length.[13]

Sustained slow stretch is slowly applied to the spastic muscles with a prolong hold proving it to be sufficient to improve or increase length of muscle .[14]

The more prolong is the duration of muscle stretch the more it reduces the excitability of motor neurons and improvement in muscles flexibility and range of motion of joints is ultimately promised.[15]

Many Researches have been done in different population to set the dose of optimum frequency and stretch hold for maximum improvement in muscle length. The previous studies support that a static stretch of thirty seconds hold at a frequency of three repetitions per single session is enough to improve the flexibility of muscles by increasing muscle length.[16] However, this study was done exclusively on diplegic spastic cerebral palsy population to investigate the effects of a higher frequency of stretching.

There is no study yet present in Pakistan analyzing the effects of frequencies of different doses of static sustained stretching on hamstring flexibility and thus reducing popliteal angle in spastic diplegic cerebral palsy. This study was done exclusively on the diplegic spastic cerebral palsy population to find out the effects of higher frequency of static sustained stretching over lower frequency. My study would provide guidelines to the physiotherapists to choose the optimum frequency of static sustained stretching based on evidence to maintain and increase the hamstring flexibility in spastic diplegic cerebral palsy children population.

Methodology

For this study we selected Rising Sun Institute for Special Children, Mughal Pura, and Defense Campus the special needs schools located in Lahore. Final effects of study were measured after four months of treatment from 4 December 2015 to April 2016. A group of 32 male spastic diplegic cerebral palsy children with ages ranging from six to twelve years, who were already taking physiotherapy treatment there were taken. Children fulfilling the inclusion criteria were assessed using the Modified Ashworth Scale (MAS) for spasticity and Universal Goniometer for popliteal angle measurement for baseline measurements. Post interventional assessment was done after the four months. Quasi-experimental study with pre-post analysis and sample size of 32 calculated from Epi tool was used. Inclusion Criteria allowed CP Children with spastic diplegia and spasticity score of 2 according to The Modified Ashworth scale (MAS), age between six to twelve years male children only.

Children with severe level of disability, epilepsy history, hip or spinal deformities, severe contractures, joint dislocations, discrepancy in leg length, had any recent orthopedic surgery, neurological disorders affecting

the study and or taking muscle relaxants were excluded from the study.

A convenient sampling technique was used for the sampling purpose. After collecting data, the study outcomes were measured using active knee extension test with Universal Goniometer. This test is evidence-based and standardized.[17]

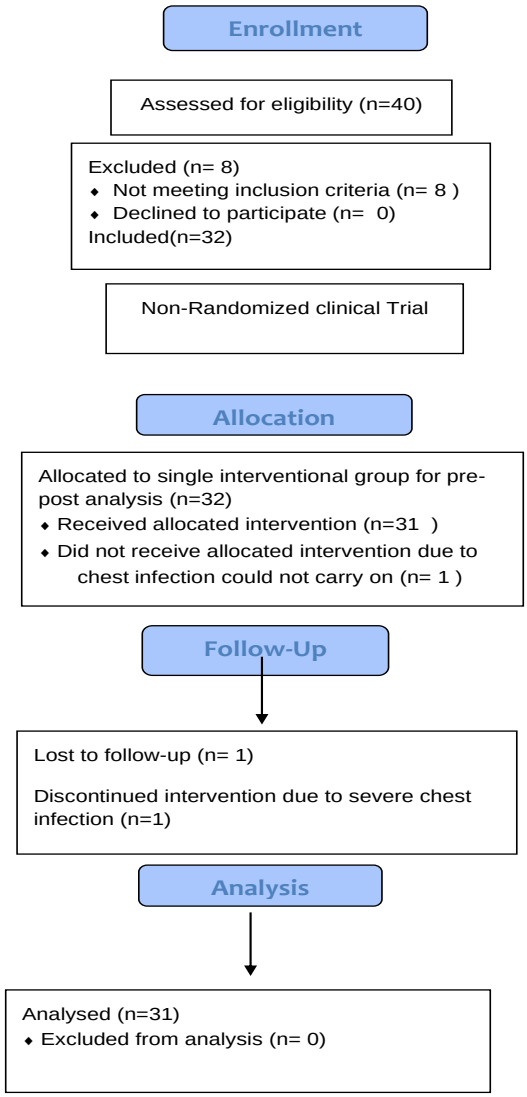
The degree of passive knee extension is measured through popliteal angle with patient lying in supine position, hip flexed at 90 degrees, extended contra-lateral limb and pelvis stabilized. An angle above 45 degree indicate hamstring tightness. [18]

Written Consent form parents of children taking part in study was taken. Children who met inclusion criteria were assessed. Pre popliteal angle ranges were measured using a universal goniometer while performing the Active Knee Extension Test. Children being treated with low frequency stretching exercises that is three repetitions for thirty seconds hold for five days per week, were now treated passively with the higher frequency of sustained stretching of that is Six repetitions sixty seconds hold for five days per week for four consecutive months. Pre and post popliteal angle ranges were measured using Universal Goniometer during Active Knee Extension Test. During the 20th day of treatment session of, one child left due to the complaints of chest infection and leaving his assessment uncompleted and sample size was reduced to 31 children only.

Children with a severe level of disability, epilepsy history, hip or spinal deformities, severe contractures, joint dislocations, discrepancy in leg length, had any recent orthopedic surgery, neurological disorders affecting the study and or taking muscle relaxants were excluded from the study.

Convenient sampling technique was used for the sampling purpose. After collecting data, the study outcomes were measured using active knee extension test with Universal Goniometer. This test is evidence based and standardized.[17] The degree of passive knee extension is measured through popliteal angle with patient lying in supine position, hip flexed at 90 degrees, extended contra-lateral limb and pelvis stabilized. An angle above 45 degree indicate hamstring tightness. [18]

Written consent from parents of children taking part in study was taken. Children who met inclusion criteria were assessed. Pre popliteal angle ranges were measured using universal goniometer while performing Active Knee Extension Test. Children being treated with low frequency stretching exercises that is three repetitions for thirty seconds hold for five days per week, were now treated passively with the higher frequency of sustained stretching of that is Six repetitions sixty seconds hold for five days per week for four consecutive months. Pre and post popliteal angle ranges were measured using Universal Goniometer during Active Knee Extension Test. During the 20th day of treatment session of, one child left due to the complaints of chest infection and leaving his assessment uncompleted and sample size was reduced to 31 children only.



CONSORT Flow Diagram

Pre and post intervention outcomes were measured using Universal Goniometer performing Active Knee Extension Test and popliteal angle was measured. Right and left both lower extremities were tested with the patient lying in supine position pelvis stabilized, contralateral limb extended and hip flexed to 90 degrees. Three Landmarks Lateral Femoral Condyle, Lateral Malleolus and Greater Femur Trochanter were used.

Universal goniometer was used and its Proximal arm was placed along the femur of testing limb and other distal arm was placed along with the lower leg. Children extended their lower extremity to their maximum stretch. Ranges were measured using circle Goniometer. On average three consecutives repetitions were taken as popliteal angle reading.

We used Wilcoxon signed rank test was used as as a non-parametric test to analyze data. For Data analysis Score presented as mean ± SD and p value < 0.05 was considered as significant. Statistical software SPSS 22 was used.

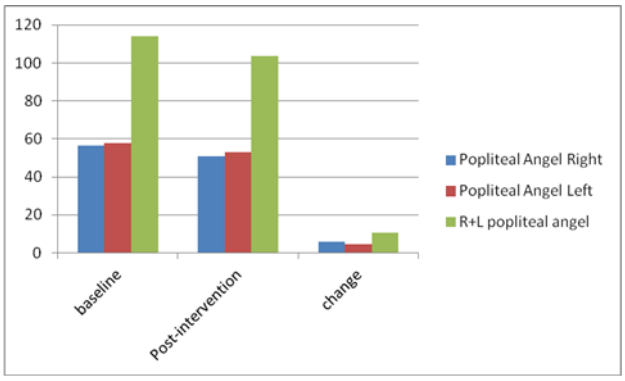
Results

Out of thirty one patients, 100% were males with mean age of 8.32±1.77 years. Significant changes in right Popliteal angle (baseline – 56.61±14.398, post 50.81±15.335) and left Popliteal angle (baseline – 57.58± 9.117, post 52.90±7.935).

Pre-Post Analysis of the study resulted in significant difference in both right and left popliteal angle. Results were significant, as P value < 0.05 was considered significant in terms of having significant effects on study. Increasing the frequency of stretching significantly decreased both right and left popliteal angle.

Discussion

This study accepted the research hypothesis that high frequency of passive sustained stretching increases hamstring flexibility more significantly by marked decrease in popliteal angle in diplegic spastic cerebral palsy children. In this study, the static stretching of high



Pre right and left popliteal angles compared with post right and left popliteal angle

frequency appears to be more effective in decreasing the popliteal angel.

Studies done by J Brent Feland et al on people aged 65 or older on the effects of duration of the Hamstring muscle stretch for increasing Range of Motion indicated that stretch of 60 seconds proved to be more effective than the stretch of 15 or 30 seconds in increasing hamstring muscle group flexibility and knee extension Range within group. [19]

However, study conducted by Bandy and Irion concluded that both 60 and 30 seconds stretch of the hamstring muscles proved equally effective in improving hamstring muscle flexibility and Range of Motion of knee joint. Bandy et al also reported no difference between 30- or 60-seconds static stretch of 1, 3 or more repetitions as well. So, these studies present the confusing picture. [20]

Researches have been done to find out the optimum frequency dose of different stretching exercises on hamstring flexibility in different populations but there is no clear picture regarding optimum frequency of static sustained type of stretching required to improve hamstring muscle flexibility in cerebral palsy children. So, this study was done to find the effects of high frequency over low frequency and which frequency is more effective in decreasing popliteal angle, increasing hamstring flexibility and improving knee extension Range of Motion. Pre-Post

Table I: Baseline VS post intervention comparison.

	Base-line Popliteal angle means and St. dev	Post-intervention Popliteal angle means and St. dev	Change in Popliteal Angle	P Value
Popliteal Angle Right	56.61±14.398	50.81±15.335	5.80	<0.0001
Popliteal Angle Left	57.58± 9.117	52.90±7.935	4.68	<0.0001
Right + Left popliteal angle	114.1935	103.7097	10.49	<0.0001

analysis of this study shows that static sustained stretching of longer duration is more effective in decreasing popliteal angle and increasing hamstring flexibility.

In our study, we used the frequency of six repetitions for sixty seconds hold for five days per week over previously given doses of low frequency of three repetitions thirty seconds hold for five days per week on the same group.

Repeated stretches were used because according to Taylor et al elongation of muscle-tendon unit is maximum after 4 repeated stretches.[21]

Straight-leg-raise method of stretching was used passively as it is easy to perform and brings maximum hamstring muscle relaxation. [22]

The high frequency of six repetitions for sixty seconds hold for five days per week appeared more beneficial than low frequency of three repetitions thirty seconds hold for five days per week in decreasing popliteal angle.

We demonstrated that higher the frequency, increased hamstring flexibility and increased Range of Motion, children had initially. Follow up studies should be done to find out how long the gained ranges and muscle flexibility preserved.

Further studies are required to compare 60-second stretches with more than 2 minutes or longer stretches of higher repetitions to determine if it is helpful in improving further Ranges.

Further studies should also be done on the subjects above 12 years or more and on other types of cerebral palsy for the generalization of this study.

Conclusion

We demonstrated that sustained stretching of high frequency 6 repetitions ,60 seconds hold 5 days per week for 4 months, had significant improvement in hamstring flexibility and knee extension Range of Motion by decreasing popliteal angle than low frequency regimens of 3 repetitions, 30 seconds hold 5 days per week in spastic diplegic cerebral palsy.

References

1. Ashwal, S., B. S. Russman, et al. "Practice parameter: diagnostic assessment of the child with cerebral palsy: report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society." Neurology.2004; 62(6): 851-863.
2. Kent RM. Cerebral palsy. Handb Clin Neurol. 2013;110:443-459.doi:10.1016/B978-0-444-52901-5.00038-1.
3. Russman BS, Ashwal S. Evaluation of the child with cerebral palsy. InSeminars in pediatric Neurology. 2004; 11(1): 47-57.
4. Shamsoddini A, Amirsalari S, Hollisaz MT, Rahimnia A, Aghda AK. Management of spasticity in children with cerebral palsy." Iran J Pediatr. 2014;24(4): 345-51.
5. Ansari, NN; Naghdi, S; Arab, TK; Jalaie, S (2008). "The interrater and intrarater reliability of the Modified Ashworth Scale in the assessment of muscle spasticity: limb and muscle group effect". NeuroRehabilitation. 23 (3): 231–7.
6. Smith LR, Lee KS, Ward SR, Chambers HG, Lieber RL. Hamstring contractures in children with spastic cerebral palsy result from a stiffer extracellular matrix and increased in vivo sarcomere length. J Physiol. 2011;589(Pt 10):2625–2639. doi:10.1113/jphysiol.2010.203364
7. R Joshua Kim BPHTY PH. The frequency of hamstring stretches required to maintain knee extension range of motion following an initial six-week stretching programme. New Zealand journal of physiotherapy. 2014 Mar 1;42(1):22.
8. Elshafey MA, Abd-Elaziem A, Gouda RE. Functional stretching exercise submitted for spastic diplegic children: a randomized control study. Rehabilitation research and practice. 2014.
9. Katz K,Rosenthal A,Yosipovitch Z. Normal ranges of popliteal angle in children." J Pediatr Orthop.1992; 12(2): 229-231
10. Elshafey MA, Abd-Elaziem A, Gouda RE. Functional stretching exercise submitted for spastic diplegic children: a randomized control study. Rehabilitation research and practice. 2014.
11. Smania N, Picelli A, Munari D, Geroin C, Ianes P, Waldner A, Gandolfi M. Rehabilitation procedures in the management of spasticity. Eur J Phys Rehabil Med. 2010 Sep 1;46(3):423-38.
12. The Effects of Stretching in Spasticity: A Systematic Review Bovend'Eerdt, Thamar J. et al. Archives of Physical Medicine and Rehabilitation, Volume 89, Issue 7, 1395 – 1406
13. De Weijer VC, Gorniak GC, Shamus E. The effect of static stretch and warm-up exercise on hamstring length over the course of 24 hours. Journal of Orthopaedic & Sports Physical Therapy. 2003 ;33(12):727-33.
14. William D Bandy, Jean M Irion, Michelle Briggler. Effect of time on static stretch and dynamic range of motionon the flexibility of hamstring muscle. J Orthop Sports Phys Ther. 1998;27(4):295-300.
15. Page, Phil. "Current concepts in muscle stretching for exercise and rehabilitation." International journal of sports physical therapy.2012;7(1):109-19.

16. Bandy, W. D., J. M. Irion, et al. The effect of time and frequency of static stretching on flexibility of the hamstring muscles. Phys Ther .1997;77(10): 1090-1096
17. Shamsi M, Mirzaei M, Khabiri SS. Universal goniometer and electro-goniometer intra-examiner reliability in measuring the knee range of motion during active knee extension test in patients with chronic low back pain with short hamstring muscle. BMC Sports Sci Med Rehabil. 2019;11:4. Published 2019 Mar 22. doi:10.1186/s13102-019-0116-x
18. Thompson NS, Baker RJ, Cosgrove AP, Saunders JL, Taylor TC. Relevance of the popliteal angle to hamstring length in cerebral palsy crouch gait. Journal of Pediatric Orthopaedics. 2001 ;21(3):383-77. 10.1097/01241398-200105000-00023.
19. Feland JB, Myrer JW, Schulthies SS, Fellingham GW, Measom GW. The effect of duration of stretching of the hamstring muscle group for increasing range of motion in people aged 65 years or older. Physical therapy. 2001 ;81(5):1110-7.20
20. Bandy WD, Irion JM. The effect of time on static stretch on the flexibility of the hamstring muscles. Phys Ther .1994; 74:845–850.
21. Taylor DC, Dalton JD, Seaber AV, Garrett WE. Viscoelastic properties of muscle-tendon units: the biomechanical effects of stretching. Am J Sports Med.1990; 18:300–309.
22. Straight Leg Raise Test. (2019, August 29). Physiopedia, . Retrieved 06:57, November 15, 2019 from https://www.physio-pedia.com/index.php?title=Straight_Leg_Raise_Test&oldid=221424.