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Original Research Article

EFFECTIVENESS OF SUSTAINED MUSCLE STRETCH WITH TILT TABLE VERSUS PASSIVE EXERCISES IN CHILDREN WITH SPASTIC CEREBRAL PALSY: A CLINICAL STUDY

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ABSTRACT

Background: The control of spasticity is habitually a major problem in the management of children with cerebral palsy which hinders in achieving the mobility and operational ability in such children.

Purpose: To determine the outcome of sustained muscle stretch or passive exercises to reduce spasticity and increase the ankle dorsiflexion range of motion which may enhance the milestone/ambulatory capacity of children with spastic cerebral palsy.

Materials and Methods: Thirty spastic diplegia and quadriplegia children according to Modified Ashworth Scale range between 1-3from both sexes ranging in age from three to eight years were randomly assigned. The children were distributed into two groups of equal number. Control group received passive exercises for 30 minutes per session per day for five days a week and study group received sustained muscle stretch of the plantar-flexors of the ankle for 30 minutes per session per day for five days a week on tilt table with ankle dorsiflexed. Spastic hypertonia was evaluated using Modified Ashworth scale as well as ankle dorsiflexion range of motion were assessed using the Universal goniometer before and after two weeks of treatment.

Results: The results show statistically significant improvement in bilateral ankle dorsiflexion range of motion in both the groups, i.e. group A receiving sustained muscle stretch and group B receiving passive exercises ($p<0.005$). However, statistically significant improvement was seen in spasticity of ankle plantar flexors on Modified Ashworth Scale score within the groups ($p>0.005$). Comparing the pre- and post-treatment mean values between two groups, there was a minimal significant difference in improvement of ankle dorsiflexion range of motion and Modified Ashworth Scale score.

Conclusion: There is minimal statistical significant in the difference in the level of spasticity showing that both treatment techniques have an equal effect on spasticity. It is further concluded that both the techniques are equally effective in increasing the range of motion of ankle dorsiflexors.

KEY WORDS: Spasticity, Tilt Table, Prolonged muscle stretch, Passive Exercises.

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INTRODUCTION

Cerebral palsy(CP) reports a group of developmental disorder of movement and posture, results in a limitation of activity which are attributed to non progressive disturbances in the developing fetal or infant brain [1]. Spastic cerebral palsy

is the commonest and accounts for 70-75% of all cases. In an analysis of 1000 cases of CP from India, it was found that spastic quadriplegia constituted 61% of cases followed by diplegia 22% and it is considered that ankle plantar flexion contractures are common problem among the population of CP [2]. Spasticity is a hypertonic motor disorder characterized by velocity dependent:-resistance to passive stretch [3]. It has been proved that there is less strength and more spasticity in the plantar flexors in children with spastic diplegic cerebral palsy [4].The modified Ashworth scale is beneficial for measuring spasticity and related problems in childhood cerebral palsy [5]. The significant results of the inter-rater reliability of manual a modified Ashworth scale on 30 children with intracranial lesions, agreed on 86.7% of the 30 ratings on spastic elbow flexors [6]. Whereas the reliability of goniometric measurements of children with cerebral palsy with moderate to severe hyper tonicity found that intra-rater variation was less than inter-rater variation for all measurements, but variations of 10 to 15° between the measurements made in two sessions by the same rater [7].

The control of spasticity is often a significant problem in the management of children with spastic CP. In the rehabilitation management of spasticity in children with spastic CP, passive stretching techniques have been used for many years. Also for the inhibition of hypertonic muscles the slow sustained and sustain stretch has been advocated [8]. The effect of long term stretch on hip adductor muscles in children with paraparesis reported 3 to 16 degrees improvement in active hip abduction (average 85%) and 1 to 9 degrees in a passive range of motion (PROM) (average 23%) after a single stretch [9]. The short term effects of a single session of sustained muscle stretch on reflex and voluntary muscle activations in children with spastic cerebral palsy reported that passive muscle stretch (PMS) led to reduced spasticity in ankle muscles as demonstrated by significant reductions of the neuromuscular responses to passive movement and these results lasted up to 35 minutes after cessation of PMS [10].

The application of sustained stretch with a constant torque not only reduce the elasticity of the hypertonic muscles but also their viscosity [11].In a study the tilt table standing in T12 spinal cord injury reported a marked reduction in spasm and lower extremity spasticity [12]. E.Bressel et., al (2007)stated that sustained static stretching is effective at reducing symptoms of spasticity and decreasing ankle joint stiffness [13].

It is also proved that Tilt Table is not recommended for children with severe extensor hyper tonus, but it can be of value for these with flexor hyper tonus in controlling the legs in a more extended position [14]. Researchers proved that the mean treatment effect on ankle mobility on femur bone mineral density by standing on tilt table is of 4 degrees and 0.005g/cm [15]. In physical rehabilitation the management of spasticity has proved that range of motion exercises are effective techniques in spasticity to improve joint motion, strength and endurance [16]. Passive range of motion (PROM) is a method that has been used for many years to reduce spasticity, contractures of any severity and all limitations of joint passive ROM This study was carried out to determine the clinical association between sustained muscle stretch through tilt table and passive mobilization techniques on ankle dorsiflexors in children with spastic cerebral palsy [17].

MATERIALS AND METHODS

This was a comparative experimental research design conducted on 20 children with spastic Diplegia and Quadriplegia cerebral palsy both genders aged 3 to 8 years. Based on the selection criteria 20 spastic CP children with Modified Ashworth Scale score 1 to 3 of ankle plantar flexors were selected by convenient sampling method and were assigned in two groups with ten children in each group. Subjects were excluded like children with spastic hemiplegia, monoplegia, limb length discrepancy, foot edema, foot bony deformities, any recent record of surgery, children suffering from any medical disorders like seizures. Before the participation, informed consent was taken from parent or caretaker of the child.

Their demographic profile and detailed medical history was collected from parents or caretakers or previous medical records. Institutional

ethical committee approval was obtained. Each subject was assessed for the level of spasticity in ankle plantar flexors on Modified Ashworth scale (MAS). Ankle dorsiflexion ROM was taken by Universal Goniometer. Then children were divided into two groups Group A and Group B. Group A received sustained muscle stretch with ankle dorsiflexed on tilt table for thirty minutes per session per day for five days a week for two weeks. The table was tilted to 85 degrees relative to horizontal and straps were offered to provide adequate support. Group B received Passive ROM exercises for ankle for thirty minutes per session per day for five days a week for two weeks. Each subject was re-assessed for the level of spasticity and ankle dorsiflexion ROM after the two weeks of treatment.

RESULTS

SPSS software was used for the analysis of data and results were expressed in t-value. The standard deviation and t test were used to check the link between the sustained muscle stretch and passive movement techniques: P<0.05 is considered to be significant. From the analysis and interpretation of data, the results show statistically significant improvement in bilateral ankle dorsiflexion ROM in both the groups, i.e. group A receiving sustained muscle stretch and group B receiving passive exercises (p<0.005). However, statistically significant improvement was seen in spasticity of ankle plantar flexors on Modified Ashworth Scale (MAS) score within the groups (p>0.005).Further when the comparison between the two groups was made, there was only a little or minimal significant difference in improvement of ankle dorsiflexion ROM and Modified Ashworth Scale (MAS) score.

Fig. 1: Comparison between Pre-MAS Score and Post-MAS Score of left and right side group A (sustained muscle stretch).

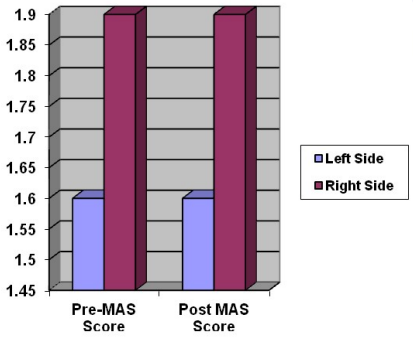


Fig. 2: Comparison between Pre-ROM and Post-ROM of ankle dorsiflexion of left and right side in Group A (sustained muscle stretch).

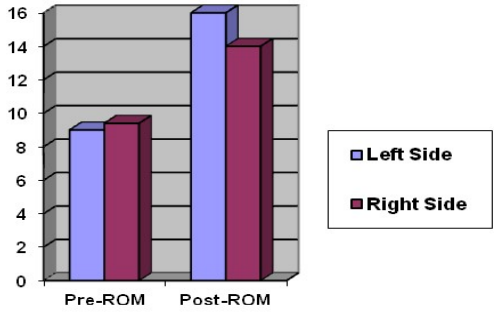


Fig. 3: Comparison between Pre-MAS Score and Post-MAS Score of left and right side in group B (passive exercises).

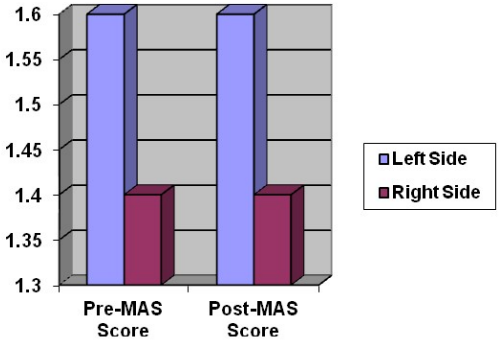


Fig. 4: Comparison between Pre-ROM and Post-ROM ankle dorsiflexion of left and right side in Group B (passive exercises).

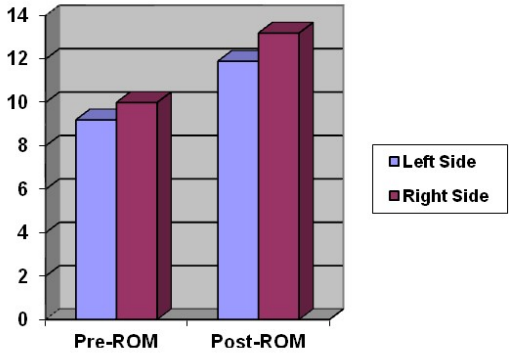
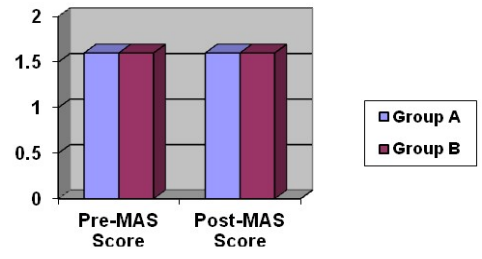


Fig. 5: Comparison of left Pre-MAS Score and left Post MAS Score between Group A (sustained muscle stretch) and Group B (passive exercises).



DISCUSSION

Descriptive statistics showed that there is significant improvement in the left and right pre and post ankle dorsiflexion ROM of both groups receiving sustained muscle stretch and passive exercises. The application of sustained muscle stretch can produce increase in ROM due to enhanced stretch tolerance without accompanying changes in muscle elasticity or neuromuscular activity [18].Similarly, Odeen I et al. (1998) stated that use of sustained muscle stretch could increased ROM in the patient with paraplegia. This is due to decrease of the muscular constraint. In this study the following parameters had shown significant improvement, left pre and post ankle dorsiflexion ROM in group A who had received sustained muscle stretch (p=0.0000), right pre and post ankle dorsiflexion ROM in group A who had received sustained muscle stretch (p=0.010), left pre and post ankle dorsiflexion ROM in group B who had received passive exercises (p=0.003), right pre and post ankle dorsiflexion ROM in group B who had received passive exercises (p=0.001) [9]. If there is significant increase in joint angle which is observed following the sustained muscle stretch, and passive exercises, the change in tissue property could be the only logical explanation [19]. Standing on tilt table in spinal cord injury having spasticity can produce mean beneficial effect on ankle mobility of 4 degrees, but it was unclear that such a small clinical effect can be proven worthwhile among clinicians and children. The evaluation of the effectiveness of 30 minutes stretch on tilt table- wedge board standing daily increased ROM of ankle dorsiflexion in children with neurological deficits [12]. While Ben. Marsha et al (2005) concluded that standing for 30 minutes; three times per week for 12 weeks has a small effect on ankle mobility and little or no effect on femur bone mineral density [15].

In present study there was no significant difference in muscle tone on Modified Ashworth scale score of left pre and right pre MAS score, left post and right post MAS score after 30 minutes of sustained muscle stretch in group A and 30 minutes of passive exercises in group B [20]. Although this scale is often used in clinics, Tsai et al (2001) revealed that it could not reflect any neurophysiological changes in spastic muscle [21]. However there is some evidence to suggest that passive stretching can reduce spasticity in children with cerebral palsy as those studies showing favorable outcome after sustained muscle stretch were mainly of higher levels of evidence and more rigorous methodology. The effect sizes were fairly small and it was difficult to judge that whether it was clinically significant [22]. It was suggested that sustained muscle stretch for 30 minutes can cause changes in the mechanical properties of intrafusal muscle fibres and in the sensitivity of receptor terminals which will modify reflex responses following changes in muscle length (either active or passive). Here researchers recommended that sustained muscle stretch at a higher velocity is less effective and the viscoelastic muscle properties require repeated session of stretching over an extended period of time. Therefore their contribution might have been negligible [10].

McPherson et al (1984) used PROM exercises for 2 years period [23]. While Miedan et al. (1987) used ankle PROM exercises for 10 weeks on children with spastic cerebral palsy and showed significant results [24]. It was suggested that standing, which is believe to help maintain normal joint movement by providing stretch to joint capsules, ligaments and muscle tendons units was not effective in reducing contractures in study cohort. The stretching forces generated by standing in the frame for 45 minutes twice a day over 6 months periods simply not sufficient to induce changes in connective tissue that lead to long standing fixed contracture [25]. Harvey. A. Lisa (2000) concluded that most of the children sat on either wheelchair or special chairs with their feet supported to 90 degree.

This and other routine interventions may have provided adequate stimuli to muscle or soft tissue structures to prevent loss of mobility and may rendered additional stretch redundant [26].It is accepted that the effect on change of range of movement at joint was fairly small, if it is less than 10 degree and one may argue that some increase in range of movement can assist in positioning of these children and it is difficult to judge if these improvement in range of move-

ment in a joint were clinically relevant [22]. As there is conflicting evidence on whether sustained muscle stretch or passive exercises can decrease spasticity in children with cerebral palsy, as those studies showing favorable outcomes after sustained muscle stretch were mainly of higher level of evidence and had more rigorous methodology, so further researches are necessary to provide information on the exact mechanism involved in improving range of movement at joint and decreasing spasticity in spastic cerebral palsy children. The present study shows that there is little or minimal significant difference between sustained muscle stretch and passive exercises. This might be due to small sample size, small duration of the study and a small area of the population which cannot be generalized. No children show negative effect i.e. regression from the scores of MAS, decline in the achieved milestones, increase in the spasticity, etc. during or after the intervention of 2 weeks. So sustained muscle stretch and passive exercises can be used in the early or late stage of rehabilitation once or several times a day as it does not cause any secondary effects.

CONCLUSION

It can be concluded that sustained muscle stretch and passive exercises showed statistically significant improvement in ankle dorsiflexion ROM in children with spastic diplegia and quadriplegia. However, there is little or minimal statistical significant in the difference in the level of spasticity showing that both treatment techniques have an equal effect on spasticity. It is further concluded that both the techniques are equally effective in increasing the ankle dorsi-flexion Range of Motion.

Scope for further studies: The same study may be carried out for larger sample size and for a longer duration of time. A similar study can be designed to see the generalization of the results in other children with motor disorder having spasticity as one component.EMG can also be used in the same study. A Study that aims to investigate the optimal duration and frequency of passive stretching to obtain the desirable clinical changes in children with spasticity can also be done.

ABBREVIATIONS

ROM – Range of motion
MAS – Modified Ashworth Scale
PMS – Prolonged muscle stretch
CP – Cerebral palsy
PROM – Passive range of motion
EMG – Electro Myograph

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Conflicts of interest: **None**

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