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Research Article

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Effect Of Structured Exercises For Achilles Tendon Tightness In Spastic Cerebral Palsy Children.

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Abstract: Cerebral Palsy (CP) is a common disorder of posture and movement caused by a non-progressive injury to the developing brain. Based on the degree of brain lesion the child can have hemiplegia , spastic diplegia or even total cerebral palsy Achilles tendon spasticity, weakness, or contracture in these conditions may lead to gait abnormalities. Achilles tendon plays an important role in performing plantar flexion and dorsiflexion of the ankle. The objective of this study was to find out the effect of structured exercises for Achilles tendon tightness prevailing in spastic cerebral palsy children. A total 34 subjects was selected for the study. Inclusion and exclusion crieteria were used to select the children for the study. Children of ages between 2 to 6 years of both sex were also considered for the study. The subjects who were not included in the study were those not willing to participate, individual's history of acute trauma or with any congenital musculoskeletal problems, previous surgery or pain in the lower limbs, Vision and hearing problems and Cardio-respiratory problems. Demographic data, assent and consent was taken from the child and their parents, respectively and the explanation of the study was given. Pre and post assessment was taken on the basis of Tardieu scale before and after 16 sessions of the treatment respectively. Each session was of 45 mins and was started with warm exercises and then functional exercises were carried out. Later evaluation and interpretation of the data was done. The study revealed that there was significant effect of structured exercises for Achilles tendon tightness in subjects with spastic cerebral palsy. The structured exercise for Achilles tendon tightness was very effective in improving the gait and strength of the spastic cerebral palsy children.

Keywords: Spastic cerebral palsy, Achilles tendon, Tardieu scale, plantar flexion, dorsiflexion, physiotherapy.

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1. INTRODUCTION

Cerebral palsy (CP) is a common disorder of posture and movement caused by a non-progressive injury to the developing brain[1] The neurological disorder can cause secondary changes in the musculoskeletal system, such as spasticity, muscle weakness and/or contractures around joints, which makes CP a leading cause of childhood disability. [2] Unlike adults with disabilities, children with CP faces the risk of secondary impairments such as soft-tissue shortening, weakness, bony deformity and further losing functional mobility during adolescence.[3] In India, over the analysis of 1000 cases of CP, it was found that spastic diplegia constituted 22% of cases followed by quadriplegia 61% and it is considered that ankle plantar movement contractures are common problems among the population of CP. [4] Preterm delivery, coexisting congenital anomalies, intrauterine infection, viral infection in pregnancy, genetic causes of CP, intrauterine growth restriction and multiple pregnancies are some of the risk factors of CP. [5] There are four types of cerebral palsy: ataxic, spastic, athetoid and mixed cerebral palsy. [6]Spastic CP is further classified as spastic hemiplegia, spastic diplegia and spastic quadriplegia. [7] Depending on the level and extent of the brain lesion, the child may suffer from hemiplegic, spastic diplegic, or total-body-involvement cerebral palsy. The Achilles tendon tightness is involved in many cases of paediatric conditions. Intrinsic tendon abnormalities such as tendinopathy and rupture are rare in the paediatric population, but the tendon is often secondarily involved in some common paediatric conditions that can be categorized under the following headings: Congenital, Developmental, Traumatic and Neurological. [8] Achilles tendon shortening or weakness is a feature of many neurological conditions affecting the central or peripheral nervous system (cerebral palsy, poliomyelitis, spina-bifida, and hereditary neuropathies) and muscles (muscular dystrophy). Achilles tendon spasticity, weakness, or contracture in these conditions may lead to gait abnormalities. [8] It is the strongest and the thickest tendon of the body. It is of 15 cm long and it originates from the middle of the back of the leg, and on the anterior surfaces, it receives some fibres of the soleus and gastrocnemius muscles almost up to its lower end. It is later inserted into the middle one-third of the posterior surface of calcaneum. Achilles tendon plays an important role in performing plantar flexion and dorsiflexion of the ankle. [9] Tardieu scale was developed by Tardieu et al. in 1954, to measure and asses the spasticity of the limbs[10] The Tardieu scale is beneficial for measuring tightness and related problems in childhood cerebral palsy. The significant results of the inter-rater reliability of manual Tardieu scale on 20 children with CP, agreed on 77% ± 13% of the 30 ratings on over all joints. [11] 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. This study is carried out to determine the clinical association of structured exercises for Achilles tendon tightness in cerebral palsy children. [12]

2. METHODOLOGY

Total of 34 subjects were approached in Krishna College of physiotherapy for this study and all the subjects who were diagnosed with spastic cp, were screened by inclusion and exclusion criteria. The procedure was explained and demographic data, assent and consent form was taken from the child and from his/ her parents, respectively. Pre and post assessment was taken on the basis of modified Tardieu scale for cp.[13] Assessment was taken before and after 16 sessions of the treatment respectively, each session was of 45mins [14] Exercises protocol was started with warm up exercises i.e. applying hot moist pack followed by passive stretching to Achilles tendon (Passive stretching of TA was done in supine lying hold the calcaneum in the hook of fingers, then traction was given at the ankle and the ankle was dorsiflexed with the forearm, holding the position for 10 counts and then leaved or relaxedor relaxed). [15] Then followed by performing functional exercises like sit to stand, normal walking, inclined walking, walking on uneven surface, walking on heels, lateral step-up, squat play. [16,17,18,19]

Subject criteria

A total 34 subjects, both male and female children were selected for the study.

Inclusion Creteria

- Age group of 2-6 years.
- Gender both male and female.
- Diagnosed Cerebral Palsy children or known case of Cerebral Palsy.

Exclusion Creteria

- Participants not willing to participate.
- Individuals with history of acute trauma.
- Individuals with congenital musculoskeletal problems.
- Previous surgery or pain in lower limb.
- Vision and hearing problem.
- Cardio-respiratory problems.

2.1 Ethical clearance

Ethical clearance was taken from institutional committee of Krishna Institute of Medical Sciences, Deemed to Be University, Karad (Protocol Number 0106/2019-22)

2.2 Outcome measures

Tardieu Scale: [11,20,21,13]

- Spasticity angle (R):

a) R1: Angle of catch seen at velocity V2or V3.
b) R2: Full range of motion achieved when muscle is at rest and it is tested at V1 velocity.

It is measured as R2-R1 = spasticity angle

- Velocity stretch (V):

a) V1: It is performed as slow as possible.
b) V2: Is performed at the speed of the limb segment falling under the gravity.
c) V3: is performed as fast as possible.

V1 is used to measure the passive range of motion, and V2 or V3 are used to measure the spasticity.

- Quality of the muscle reaction (X):

1. No resistance throughout the passive movement.
2. Slight resistance throughout the passive movement.

3. Clear catch at a precise angle, interrupting the passive movement, followed by release.
4. Fatigable clonus (<10 s when maintaining pressure) occurring at a precise angle, followed by release.
5. Unfatigable clonus (>10 s when maintaining pressure) occurring at a precise angle.

3. STATISTICAL ANALYSIS

Statistical analysis of the recorded data was done by using the software SPSS version 20. The paired T-test and one way ANOVA test were used for analysis of data.

4. RESULTS

Table 1. Gender Distribution

Gender	Total
Male	22
Female	12
Total	34

Table 1 represents, a total of 34 subjects were taken for the study. Out of 34 subjects 22 were males and 12 were females.

Table 2. Age Distribution

Age	Total
2-4 years	26
5-6years	8

Table 2 represents, two age groups i.e. 2-4 years which included total 26 subjects and in other age group 5-6 years it included total 8 subjects.

Table 3. Muscle reaction (X)

Movement	Pre interventional (x)	Post interventional (x)	T value	P value	Result
PF	2.294±0.6244	1.706±0.5746	5.717	<0.0001	CVS
DF	2.265±0.6137	1.618±0.5992	6.221	<0.0001	CVS

Table 3 represents the pre interventional mean ± SD of muscle reaction (X) of plantar flexion was 2.294±0.6244, whereas post interventional mean ± SD was 1.706±0.5746; and pre interventional mean ± SD of muscle reaction (X) of dorsiflexion was 2.265±0.6137, whereas post interventional mean ± SD was 1.618±0.5992. It concluded that interference was considered very significant with P value<0.0001.

Table 4: Velocity stretch (R1)

Movement	Pre interventional (R1)	Post interventional (R1)	T value	P value	Result
PF	22.64±6.828	27.72±6.988	4.282	<0.0001	CVS
DF	6.323±2.222	9.485±2.269	8.209	<0.0001	CVS

Table 4 represents the pre interventional mean ± SD of velocity stretch (R1) of plantar flexion was 22.64±6.828, whereas post interventional mean ± SD was 27.72±6.988; and pre interventional mean ± SD of velocity stretch (R1) of dorsiflexion was 6.323±2.222, whereas post interventional mean ± SD was 9.485±2.269. It concluded that interference was considered very significant with P value<0.0001.

Table 5. Velocity stretch (R2)

Movement	Pre interventional (R2)	Post interventional (R2)	T value	P value	Result
PF	29.33±7.171	36.17±6.809	5.703	<0.0001	CVS
DF	9.353±1.968	13.882±1.689	14.403	<0.0001	CVS

Table 5 represents the pre interventional mean ± SD of velocity stretch (R2) of plantar flexion was 29.33±7.171, whereas post interventional mean ± SD was 36.17±6.809; and pre interventional mean ± SD of velocity stretch (R2) of dorsiflexion was 9.353±1.968, whereas post interventional mean ± SD was 13.882±1.689. It concluded that interference was considered very significant with P value<0.0001.

Table 6. R2-R1

Movement	Pre interventional (R2-R1)	Post interventional (R2-R1)	T value	P value	Result
PF	6.691±2.814	8.456±3.691	3.135	<0.0021	CVS
DF	3.029±0.711	4.397±1.547	6.624	<0.0001	CVS

Table 6 represents the pre interventional mean ± SD of velocity stretch (R2-R1) of plantar flexion was 6.691±2.814, whereas post interventional mean ± SD was 8.456±3.691; and pre interventional mean ± SD of velocity stretch (R2-R1) of dorsiflexion was 3.029±0.711, whereas post interventional mean ± SD was 4.397±1.547. It concluded that interference was considered very significant with P value<0.0001.

5. DISCUSSION

Cerebral palsy (CP) is a common disorder of posture and movement caused by a non-progressive injury to the developing brain.[1] The neurological disorder can cause secondary changes in the musculoskeletal system, such as spasticity, muscle weakness and/or contractures around joints, which makes CP a leading cause of childhood disability. [2] The Achilles tendon tightness is involved in many cases of paediatric conditions. Achilles tendon plays an important role in performing plantar flexion and dorsiflexion of the ankle. [9] Achilles tendon spasticity, weakness, or contracture in these conditions may lead to gait abnormalities. [8] Tardieu scale was developed by Tardieu et al. in 1954, to measure and asses the spasticity of the limbs[10]. It was further modified by Held and Peierrot-Deseilligny[20] and it was later modified by Boyd and Graham, the Tardieu scale is presently known as Modified Tardieu Scale (MTS).[21] This research was undertaken with the aim to study the effect of structured exercises for Achilles tendon tightness in spastic cerebral palsy children. The study was carried out and the result was drawn by using modified Tardieu scale. A total 34 subjects were selected for the study who fulfilled inclusion criteria. The procedure was explained and consent was taken from those willing to participate and written assent was taken from caregivers. Demographic data, assent and consent form was taken from the child and from his/ her parents, respectively. Subjects were selected for the study according to the inclusion and exclusion criteria using convenience sampling method. Pre and post assessment was taken on the basis of modified Tardieu scale for cp.[13] Assessment was taken before and after 16 sessions of the treatment respectively, each session was of 45mins. [14] Exercise protocol was started with warm up exercises i.e. applying hot moist pack followed by passive stretching to Achilles tendon (Passive stretching of TA was done in supine lying, holdinging the calcaneum in the hook of fingers, giving traction at the ankle and then dorsiflex the ankle with the forearm, holdinging the position for 10 counts and then leave or relaxing). [15] Then followed by performing exercises like sit to stand, normal walking, inclined walking, walking on uneven surface, walking on heels, squat play. [16] It was found that 34 subjects were taken for the study. Out of 34 subjects, 22 were males and 12 were females. They were categorised between two age groups i.e. 2-4 years which included total 26 subjects and in other age group 5-6 years it included total 8 subjects. The study showed that in muscle reaction (X) pre interventional mean and standard deviation of plantar flexion was 2.294±0.6244, whereas post-interventional mean ± SD was 1.706±0.5746. And the pre interventional mean and standard deviation of muscle reaction (X) of dorsiflexion was 2.265±0.6137, whereas post-interventional mean ± SD was 1.618±0.5992. It concluded that interference was considered very significant with P value <0.0001. In velocity stretch (R1) the pre interventional mean and standard deviation of plantar flexion was 22.64±6.828, whereas post-interventional mean ± SD was 27.72±6.988. And pre interventional mean and standard deviation of velocity stretch (R1) of dorsiflexion was 6.323±2.222, whereas post-interventional mean ± SD was 9.485±2.269. It was concluded that interference was considered very significant with P value <0.0001. In velocity stretch (R2) the pre interventional mean and standard deviation of plantar flexion was 29.33±7.171, whereas post-interventional mean ± SD was 36.17±6.809; and pre interventional mean and standard deviation of velocity stretch (R2) of dorsiflexion was 9.353±1.968, whereas post-interventional mean ± SD was 13.882±1.689. It was concluded that interference was considered very significant with P value <0.0001. The study also showed that the pre interventional mean and standard deviation of velocity stretch (R2-R1) of plantar flexion was 6.691±2.814, whereas post-interventional mean ± SD was 8.456±3.691; and pre interventional mean and standard deviation of velocity stretch (R2-R1) of dorsiflexion was 3.029±0.711, whereas post-interventional mean ± SD was 4.397±1.547. It concluded that interference was considered very significant with P value <0.0001. Based on the statistical results, it is concluded that the structured exercise for Achilles tendon tightness was very effective in improving the gait and strength of the spastic cerebral palsy children.

6. CONCLUSION

On the basis of the results of the study, it can be concluded that the structured exercises for Achilles tendon tightness was effective in improving the gait and strength of the spastic cerebral palsy children. Also, it shows that there was a significant effect of structured exercises for Achilles tendon tightness in subjects with spastic cerebral palsy.

7. AUTHORS CONTRIBUTION STATEMENT

Miss. Sangeeta A. Yadav conceptualized and gathered the data with regards to this work. Dr. Namrata Kadam analysed these data and necessary inputs were given towards the designing of the manuscript. All authors discussed the methodology and results and contributed to the final manuscript.

8. CONFLICTS OF INTEREST

Conflicts of interests declared none.

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