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The Clinical Effectiveness of AFOS & Exercises in Children with TOE Walking

Samreen Izhar[1*], Noureen Fatima[2], Sana Farooq[1], Nida Zakir[1], Syed Hasan Abbas Rizvi[3]
[1]Senior Lecturer & Senior Physiotherapist (DPT, MScPt), School of Physiotherapy & Rehabilitation, Liaquat National Hospital, Karachi, P.O Box No 74800, Pakistan
[2]Lecturer & Physiotherapist (DPT, MSc Pt), School of Physiotherapy & Rehabilitation, Liaquat National Hospital, Karachi, P.O Box No 74800, Pakistan
[3]Associate Professor& HOD Department of Physiotherapy (DPT, MScPt, MPA), School of Physiotherapy & Rehabilitation, Liaquat National Hospital, Karachi, P.O Box No 74800, Pakistan

Original Research Article

***Corresponding author**
Samreen Izhar

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Abstract: The objective of this study is to explain the importance of use of AFOs and exercise in children with toe walking due to calf muscle tightness, to provide advance rehabilitation techniques that can reduce the effects of progressive contractures, postural deformities and imbalance and to explain the best treatment and guidelines to parents to make the child maximum independent. This is an experimental based study in which participants are randomly selected. Fifty male and female participants (children) of age between 03 yrs –12 yrs are selected who presents with toe walking due to tightness in Achilles tendon. All participants are assessed prior to treatment and then reassessed after three month of therapy. Data was collected through an assessment form. Data was analyzed by the paired T-test statistics .The result shows a significant difference (p=0.00) in the variables of cadence, pain (VAS), ankle dorsiflexion & planter flexion range (p<0.005).The mean result for pre and post cadence is (-5.820), post treatment cadence improved because of achieving improved ankle dorsiflexion range. The study demonstrated that use of AFOS and exercises can achieve good ankle function and range of motion can be improved .The study shows that children with Toe walking due to Achilles tendon tightness can improve their walking pattern and ADLs by the use of AFOS & exercises.
Keywords: Tight Achilles tendon, AFOS, Toe walking, Range of motion, Exercises.

INTRODUCTION

Toe walking is a condition that impairs the most common Activity of Daily Living (ADL), ambulation. A substantial number of patients suffer from this pathology, which may be due to underlying neurological disease (i.e. cerebral palsy) or may be idiopathic in nature. Excessive ankle plantar flexion affects a child's gait pattern and disables the ability for functional play, such as single leg standing, jumping or hopping, and all symmetrical bilateral coordination activities [1].

Associated with many diseases, such as cerebral palsy, myopathy and neuropathy, toe-walking is a very common gait deviation that is defined as an absence of the first rocker. Three distinct kinematic ankle patterns have been identified in the toe-walker gait for a large variety of diseases .The first pattern shows progressive dorsiflexion during the stance phase, while the second presents a short dorsiflexion, followed by a progressive plantar flexion. The third group exhibits a double bump aspect, moving successively from a short dorsiflexion, to a short plantar flexion, returning to a short dorsiflexion and ending with a plantar flexion until toe-off [2].

Toe walking refers to a walking pattern in which a child walks on the balls of their feet and there is no contact between the heels and the ground. There are many medical reasons for this type of walking pattern. Idiopathic toe walking, sometimes referred to as habitual or behavioral, occurs when a child walks on the balls of their feet for an unknown reason. This term applies to toe walking in a child who has been evaluated by their doctor and no medical reason has been identified. Idiopathic toe walking occurs in otherwise healthy and typically developing children. It always occurs in both feet. Some children with idiopathic toe walking are able to walk with their feet flat when asked to do so. When these children wear shoes, they might not walk on their toes. Their toe walking is often exaggerated when they walk bare-footed from one room to another or when they walk on surfaces that have increased tactile sensations (carpet, cold tile, grass). These children typically do not have tightness in their Achilles' tendons (heel cords) early on [3]. Given that people with upper motor neuron typically have the greatest impairment distally at ankle and knee with relatively preserved strength proximally, toe walking could offer a more feasible means of mobility than normal heel-toe walking [4].

Toe walking, or equines gait, may occur in otherwise normal children or in children with neuromuscular disorders. Neutrogena equines, this deformity is common in children with cerebral palsy, muscular dystrophy, and incompletely treated clubfeet. Correction usually requires lengthening of the heel-cord and sometimes opening of the ankle joint capsule. Idiopathic toe walking: Persistent toe walking in infants and young children is uncommon and usually due to shortening of the triceps muscle [5]. Idiopathic toe walking is a common condition in children under 3 yrs of age. By 3 yrs of age children walk with a heel strike. Persistent toe walking beyond this age is abnormal. Little is known about the natural history of idiopathic toe walking, with most individual with improving or showing resolution prior to the age of 6.persistent toe walking in older child or young adults can lead to leg pain, more activity related and frequently in anterior tibial or knee regions. Toe walking developing sometimes after birth can be associated with problematic conditions such as muscular dystrophy, dystonia, tethered cord syndrome, central nervous system neoplastic processes or autism. In children who toe walk, walking in generally not delayed as a development milestone and when this occurs, conditions like spastic diplegia should be considered. A few beats of the clonus at the ankle can be helpful in differentiating associated mild diplegia from idiopathic toe walking [6].

The treatment of ITW [idiopathic toe walking] begins with instructions given to the parents regarding the importance of a long-term commitment to assisting the child with both heel cord stretching and dorsiflexion strengthening exercise. If toe-walking persists, serial heel cord dorsiflexion casts should be considered. After casting, articulated AFOs with plantar-flexion stops are used fulltime. If the use of serial stretching casts does not realize a satisfactory clinical improvement in the tendency to toe-walk, then heel cord lengthening procedures will be necessary to effect a change in gait. Persistent toe-walking secondary to a heel core contracture can potentiate both forefoot splay and a disproportionately wide forefoot compared to the heel. Standard footwear may not accommodate the wide forefoot and narrow heel. External tibial torsion frequently develops to compensate for the lack of foot flat contact. This external tibial torsion deformity becomes more obvious once the heel cord has been lengthened. It may be severe enough to warrant corrective osteotomy" [7]. Toe walking is the inability to generate a heel strike during the initial contact phase of the gait cycle, and the absence of full foot contact during the entire standing phase. It is a pattern sometimes observed in healthy developing children less than 2 years old who are learning to walk independently [8]. Types of Toe-Walking: Idiopathic: Idiopathic toe-walking is a term used to describe the condition in which children walk with a toe-toe gait pattern in the absence of any known cause. It has been referred to as habitual toe-walking. Autism Spectrum Disorder (ASD) / Sensory Seeking: Some children may toe-walk secondary to needing a certain type of sensory stimulation that is present when they are walking on their toes. There is no shortening or spasticity found in the calf muscles, the reason is just purely sensory. Cerebral Palsy (CP): Children who have mild CP may toe-walk because their calf muscle(s) (gastrocnemius) are affected by the CP and are spastic. The spasticity causes the calf muscles to continuously contract and pulls the foot so that the child is pointing their toes in sitting or is up on their toes in standing. Over time if the spasticity is not regulated or reduced the muscle may get used to being in this shortened position and become tight and harder to move out of the toe pointed position [9].

Gait is the pattern or manner in which walking is performed and can be normal, abnormal, or unsteady. Gait analysis can be assessed by various techniques but is most commonly performed by clinical evaluation incorporating the individual's history, physical examination, and functional assessment. The features of gait analysis that make it important and valuable as a research tool are its objectivity and ability to compute things that cannot be felt by the patient or seen by an observer. Quantitative gait analysis is useful in objective documentation of walking ability as well as identifying the underlying causes for walking abnormalities in patients with cerebral palsy, stroke, head injury and other neuromuscular problems. The results of gait analysis have been shown to be useful in determining the best way for treatment regarding gait abnormalities and performance enhancement. Some of the necessary components for a complete gait analysis are the recording of: movement during data collection, joint range of motion and strength, bony abnormalities, temporal and stride parameters, joint kinematics in three dimensions, joint kinetics and muscle activation patterns during gait [10].

Non operative treatment including heel cord stretching with calceneous midline or inverted can be helpful when perform on a regular basis along with dorsiflexion strengthening exercises. Stretching a tight heel cord with the hind foot in valgus contribute to midfoot breakage while being ineffective in lengthening planter flexion soft tissues. Articulating AFOS with planter flexion blocks or posterior leaf spring types can be helpful in maintaining position both day and night.

Serial casting can be an option for resistant equinous deformity not felt to be surgical at the time. Casting should occur with maximal dorsiflexion as tolerated, again with the heel in a neutral or slightly inverted position. Two or three sets of short-leg casts of the walking nature, lengthening the heel cord, can result in greater passive dorsiflexion. Short-term weakness of the anterior tibialis and dorsiflexors can be anticipated post casting requiring additional strengthening intervention. Clostridium botulinum toxin A injections can be helpful also in weakening partially the plantar flexors, facilitating improved stretch into dorsiflexion along with relative strengthening of active dorsiflexion. Orthotics can be weaned over three to six months once toe walking has resolved and improvements obvious. Night time splinting can be discontinued in the absence of recurrent toe walking.

Surgical intervention, including heel cord lengthening and/ or gastrocsoleus recession, is reserved for those who have failed conservative trial. Toe walking after the age of 6 years often does not improve, and heel cord contractures can worsen. External tibial torsion can progress further developing as compensation for lack of foot-flat contact. The torsion may be severe enough with excessive external foot progression angle to warrant corrective osteotomy. Surgical lengthening is performed sufficient to obtain 10 degrees of dorsiflexion with the knee extended. Over lengthening of the heel cord can be disastrous, resulting in persistent crouched gait and associated pain syndromes and limitations. In more severe and chronic equinous deformities, posterior ankle capsular release may be required. Short-leg casting postoperatively is common up to six weeks followed by custom-molded AFOs for up to two months thereafter. Home exercise, along with physical therapy for gentle heel cord stretching and strengthening ankle dorsiflexion, is mandatory or recurrent equinous deformity can be anticipated. Long-term outcomes of surgical lengthening in skilled hands are generally positive when recommendations are followed with satisfactory heel-toe walking over the lifetime [11].

An ankle-foot orthosis (AFO) is a hard brace worn on the lower leg to support an ankle and foot. This device keeps the ankle in a neutral position during walking and other daily activities. The AFO gently raises up your foot, ankle, and toes to keep your toes from dragging on the ground while walking. This helps to improve your overall safety and speed with walking [12].

AFOS may be prescribed for several reasons: to maintain posture, to prevent deformity, and to obtain a biomechanical effect. They may be use for walkers and nonwalkers. The manufacture of an orthosis depends upon an accurate, positive plaster cast of the child's foot and calf from which a lightweight thermoplastic splint is manufactured .apart from static functions such as preventing deformity and maintaining posture, the orthosis can be used to alter the biomechanical forces acting upon joints. When the foot is applied to the ground, an equal and opposite reaction force is generated in response to this load (Newton's third law). The ground reaction force has magnitude in three directions and can be measured with a force plate. The AFOS prevent excessive tibial progression. They are usually worn in normal shoe wear, and these shoes have a slightly heel raised. The shank axis need to be perpendicular to the floor as in normal standing and the height of the heel on the shoe needs to be taken into account when setting the foot shank angle of AFOS.A little planter flexion (equinus) of about 5 degrees is often left in the AFO so that the AFO shoe wear combination give a satisfactory orientation of the shank to the vertical [13]. It should be noted that orthosis used to hold or correct significant deformity can induce marked pressure problems in the area of the skin contact. These molded orthosis tend to increase the rigidity of foot, require regular replacement due to growth and are expensive [14]. There are different types of ankle-foot orthoses available. Your physical therapist can help you choose the best one for your specific condition. The standard AFO may be large and a bit clunky, but it may be necessary to fully stabilize your ankle and foot while walking. A smaller, more mobile AFO may be one with a posterior leaf spring. This type of AFO has a small, springy back that stretches and stores energy when you step. As you raise your foot off the ground, the posterior leaf spring helps to add a little spring in your step, quickly raising your foot and toes off the ground. Another type of ankle-foot orthosis is one with a lateral or anterior leaf spring. The benefit to that is that it may be a little more streamlined and less visible when you are walking. A word of caution: using an ankle-foot orthosis may rub abnormally on your foot and ankle, leading to skin wear and breakdown. You must check your foot daily for any signs of skin irritation. This may include: Skin redness, Chaffing, Warmth to touch, and Bleeding. If you notice any of these conditions, discontinue use of your ankle-foot orthosis and see your doctor right away. You may need to have your AFO adjusted to fit properly. If you are dealing with foot drop, you may benefit from using a device called an ankle-foot orthosis in your shoe. The device, when fitted and worn properly, can help you walk with an improved stride and more safety. Your physical therapist can help you obtain and properly wear your ankle-foot orthosis [15].

"A misaligned orthosis can create imbalance issues that force the patient to compensate in order to maintain an upright posture in standing or walking," he said. "If a patient is fitted with an AFO and tells the clinician they feel more unsteady, some practitioners just tell them they'll get used to it. We have to be very careful about that, because they may not" [16]. The effect of AFOs on sensory feedback may be helpful or deleterious, depending on the condition of the patient [16].

Casts, orthoses, and splints are often used for children with neurological conditions to improve limb positioning and increase functional movement [17]. Casting does appear to benefit for idiopathic toe walker in the short term by improving ankle dorsiflexion and stopping toe walking in the majority of cases. Study shows that the non invasive treatment should be considered in the first instance, reserving surgical options for the resistant cases [18].

Several sessions to work on stretching the tight muscles may be beneficial to decrease the amount of toe walking. Children will also benefit from completing stretching exercises at home [19]. Some children may benefit from an ankle-foot orthosis (AFO) to help encourage a flat foot with walking. The AFO is a custom brace used during the daytime to help stretch and encourage a flat foot position. If worn at night, the AFO can help stretch the tight muscles while a child is sleeping [19].

Stretches include: Static /Passive Stretches (Manual Calf Stretch, Wall Stretch, Towel / Long Sit Stretch, Heel Drop Stretch), Active Stretches and Strengthening (Squat Play, bear walk, scooter race, Heel Walking, child pose) [9]. One study in reviewing literature is the use of Dynamic splinting home therapy for toe walking, it was a case report showed improvement in walking in children with toe walking [20].

Idiopathic toe walking can be treated with serial casting & aggressive wearing of AFOs with or without botulinum toxin A injections. The patients who initially wore their AFOs 23 hours/day had significantly better results. The patients who only wore their AFOs during the day had a much higher rate of persistent toe-walking and recurrence of toe-walking [21].

An article on "Effectiveness of Casts, Orthoses, and Splints for Children with Neurological Disorders" reports the results of a critical review of the literature examining the effectiveness of casts, orthoses, and splints for the upper and lower extremity when used for children with cerebral palsy or brain injury. Results indicate that for children with cerebral palsy, hands splints improve grasp, and upper extremity casts lead to increased range of motion and decreased muscle tone. The effects on upper extremity function need to be studied further. For lower extremity casts, orthoses, and splints, there is evidence to support their effectiveness for children with cerebral palsy in improving range of motion at the ankle, leading to changes in the quality of walking. For children with traumatic brain injury, there is less information on the effects of casts, orthoses, and splints for both the upper and lower extremity. Further research in this area is needed [17]. A formal trial between two opposing theories about the orthotic management of ITW was recently published by Herrin and Geil. The authors describe the recruitment and subsequent observations of 18 children diagnosed with ITW between the ages of two and eight years old. Exclusions from this convenience sample included the presence of any neurologic condition, prior treatment of an Achilles tendon contracture (such as with serial casting or surgery), and the presence of a plantar flexion contracture. Subjects were randomly assigned to one of two treatment modalities. The AFO group received a custom articulated AFO, fabricated from 1/8-inch polypropylene with a plantar flexion stop, which prevented plantar flexion beyond a 90 degree alignment. Tamarack ankle joints allowed unrestricted motion into dorsiflexion beyond 90 degrees. The AFOs had a full-length toe plate with medial and lateral footplate trim lines proximal to the metatarsal heads. The foot orthotic (FO) group received custom FOs, fabricated from 1/8-inch puff and 1/8-inch Poron® with a cork base and a full-length, firm, carbon fiber footplate. Guardians of the children in both cohorts were asked to ensure that the children wore the assigned devices at all times over a six-week period, except during sporting activities and sleep. The recruited subjects presented with an average age of five years. Eleven of the 18 subjects had begun toe walking at the same time they began walking. For the remaining subjects, ITW was acquired later, such that the average age the subjects began walking was 12 months and the average age of toe walking was 18 months. The average range of passive dorsiflexion was about 4 degrees and the parents of all 18 subjects confirmed that their children could walk normally if asked to do so [22].

In one study clinically prescribed orthoses demonstrate an increase in velocity of gait in children with cerebral palsy: a retrospective study. The purpose of this study was to determine the effect clinically prescribed ankle–foot orthoses (AFOs) have on the temporal-spatial parameters of gait, as compared with barefoot walking in children with cerebral palsy [23]. Changes in muscle activity in children with hemiplegic cerebral palsy while walking with and without ankle–foot orthoses. The HAFO also slightly decreased muscle activity in the proximal leg muscles mainly during swing phase, improved stride length, decreased cadence, improved walking speed, increased peak hip flexion, improved kinematics in loading response phase at the knee, and reduced the excessive ankle plantar flexion [24].

A literature on Habitual toe-walkers was conducted "A clinical and electromyography gait analysis". Six children who were habitual toe-walkers were studied using electromyography techniques. In the initial gait evaluation, the muscle synergy pattern was found to be abnormal during the toe-toe gait as well as during the heel-toe gait. After treatment with casts, each patient had a normal electromyography pattern during heel-toe gait [25]. Non-surgical treatment of ITW does not have a lasting effect and the long-term results in this study are considered to reflect the natural history, i.e. the toe-walking pattern eventually resolves spontaneously in the majority of children. Surgical treatment of ITW should be reserved for the few cases with a fixed ankle-joint contracture [18]. Achilles tendon lengthening improves ankle kinematics without compromising triceps surae strength; however, plantar flexion power does not reach normal levels at 1 year after surgery [26]. As one research says: the use of an ankle-foot orthosis resulted in a significant decrease in the energy cost of walking of quadriplegic children with cerebral palsy, compared with barefoot walking, whereas it remained unchanged in hemiplegic and diplegic children with cerebral palsy. Energy cost reduction was related to both a faster and more efficient walking pattern. The improvements in efficiency were reflected in changes of stance and swing phase knee motion, i.e. those children whose knee flexion angle improved toward the typical normal range demonstrated a decrease in energy cost of walking, and vice versa. Another research say: the use of an AFO significantly reduced the EC of walking in more severely involved CP children (quadriplegics), compared with barefoot walking, whereas it remained unchanged in mildly involved CP children (hemiplegics and diplegics). The reduction in EC was related to both a faster and a more efficient walking pattern. However, the improvements in efficiency were not profoundly reflected in changes in gait parameters, except for stance and swing phase knee motion [27].

MATERIALS AND METHODS

This was experimental based study.

- Simple random sampling technique was applied so that each patient of the selected population thus has an equal probability of selection.
- 50 male & female children were recruited from among patients presenting for physiotherapy treatment of gait abnormality. Patients who satisfy the inclusion criteria were enrolled to participate in the study.

The inclusion criteria:

- Participants were in the age group of 03-12 yrs.
- Were children with toe walking (unilateral or bilateral), cerebral palsy, development delay, muscular dystrophy, post traumatic conditions.

The exclusion criteria:

- Children below 03 yrs & above 12 yrs
- Children undergone some surgical procedure of Achilles tendon
- Children undergone some POP cast treatment
- Children with Achilles tendon injury or tendonitis or trauma
- Children showing aggressive behavior
- Children have any psychological problem
- Children receiving botox therapy.

THE METHODOLOGY

Goniometry has been used as an apparatus. Assessment form has been used to carry out experiment. Data was collected from Liaquat National Hospital (Department of Physiotherapy) with their kind approval for this randomized controlled trial. The method was divided into three phases, a protocol development phase, an implementation or intervention phase and a follow-up phase. During the protocol phase, a consent form was designed and assessment form was designed. During the intervention phase, a group, with participants being randomly selected. This method will allow for the analysis of the effects of treatment over time. The outcome measures in the study will be assessed before and after the sessions. During the follow-up phase, there is an analysis of the stability of the effect of treatment over time. Participants came thrice per week for 3 month follow up. Participants were given exercises once a day and advised to wear AFOS 12 hours a day, then participants were reassessed after three month. After data collection statistical analysis was performed by using SPSS 21 to see the effects of therapy.

Data was analyzed by the Paired sample T- test with level of significance < 0.05. Descriptive statistics include mean, median, standard error, standard deviations using 95% confidence interval (upper and lower boundary).

RESULTS

Exercise and use of AFOS led to statistically significant improvements in quality of life as assessed by comparing pre and post treatment differences. Results were analyzed by using statistical paired T-test on the basis of pre and post treatment variables which includecadence, pain on VAS scale, range of motion at ankle joint, difficulty in walking. Pain on VAS showed a decrease in threshold. The range of motion at ankle dorsiflexion and planter flexion increased and therefore cadence is increased with mild to moderate improvement in difficulty in walking.

The mean, standard deviation, standard error and correlation are mentioned in Table 1& 2. Results in all variables are significant p=0.00.

The standard error mean (SDM) for pre and post treatment pain (VAS) is 0.146(95% confidence interval lower boundary 0.507 and upper boundary 1.093), T=5.49.

- SDM pre and post treatment cadence is 0.777(95% confidence interval lower boundary -7.382 and upper boundary -4.258), T= -7.940
- SDM pre and post treatment difficulty in walking is 0.071(95% confidence interval lower boundary -0.583 and upper boundary -0.297), T= -6.29
- SDM pre and post treatment right foot dorsiflexion is0.472 (95% confidence interval lower boundary -9.249 and upper boundary-7.351), T= -17.57
- SDM pre and post left foot dorsiflexion is 0.487 (95% confidence interval lower boundary -9.278 and upper boundary-7.322), T=-17.051
- SDM pre and post treatment right foot planter flexion is 0.930 (95% confidence interval lower boundary -11.570 and upper boundary-7.830), T= -10.426
- SDM pre and post treatment left foot planter flexion is 0.532 (95% confidence interval lower boundary -9.170 and upper boundary -7.030), T= -15.241

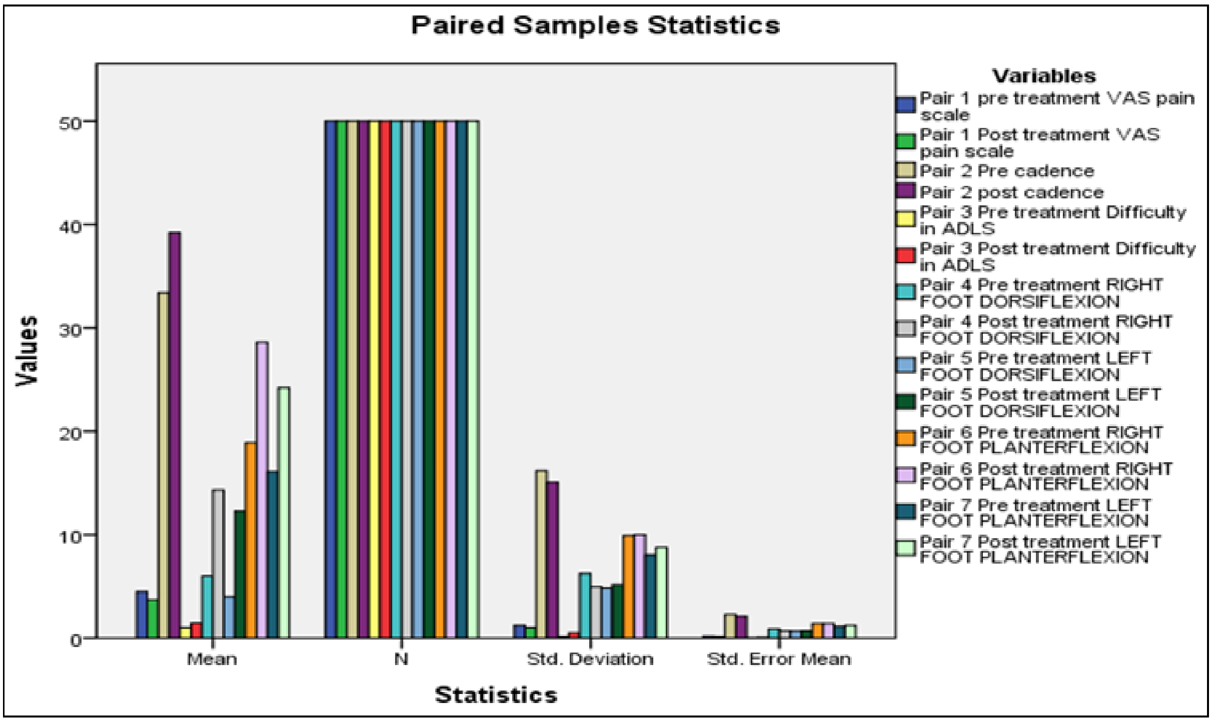
The significance and description is shown below with graphs and tables.

Table-1: Paired Samples Correlations

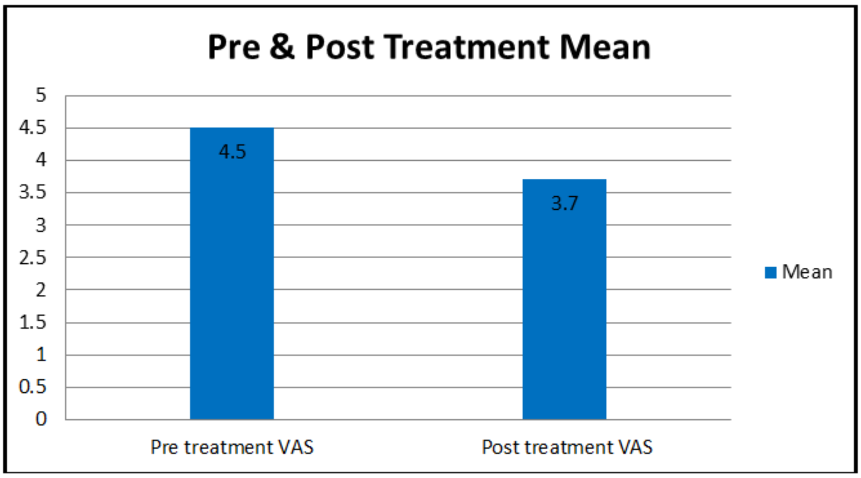
		N	Correlation	Sig.
Pair 1	pre treatment VAS pain scale & Post treatment VAS pain scale	50	.595	.000
Pair 2	Pre cadence & post cadence	50	.941	.000
Pair 3	Pre treatment Difficulty in ADLS & Post treatment Difficulty in ADLS	50	.155	.283
Pair 4	Pre treatment RIGHT FOOT DORSIFLEXION & Post treatment RIGHT FOOT DORSIFLEXION	50	.847	.000
Pair 5	Pre treatment LEFT FOOT DORSIFLEXION & Post treatment LEFT FOOT DORSIFLEXION	50	.766	.000
Pair 6	Pre treatment RIGHT FOOT PLANTERFLEXION & Post treatment RIGHT FOOT PLANTERFLEXION	50	.782	.000
Pair 7	Pre treatment LEFT FOOT PLANTERFLEXION & Post treatment LEFT FOOT PLANTERFLEXION	50	.903	.000

Table-2: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre treatment VAS pain scale	4.50	50	1.233	.174
	Post treatment VAS pain scale	3.70	50	1.015	.144
Pair 2	Pre cadence	33.40	50	16.205	2.292
	post cadence	39.22	50	15.069	2.131
Pair 3	Pre treatment Difficulty in ADLS	1.02	50	.141	.020
	Post treatment Difficulty in ADLS	1.46	50	.503	.071
Pair 4	Pre treatment RIGHT FOOT DORSIFLEXION	6.02	50	6.258	.885
	Post treatment RIGHT FOOT DORSIFLEXION	14.32	50	4.963	.702
Pair 5	Pre treatment LEFT FOOT DORSIFLEXION	4.00	50	4.845	.685
	Post treatment LEFT FOOT DORSIFLEXION	12.30	50	5.172	.731
Pair 6	Pre treatment RIGHT FOOT PLANTERFLEXION	18.90	50	9.912	1.402
	Post treatment RIGHT FOOT PLANTERFLEXION	28.60	50	10.002	1.415
Pair 7	Pre treatment LEFT FOOT PLANTERFLEXION	16.10	50	8.036	1.137
	Post treatment LEFT FOOT PLANTERFLEXION	24.20	50	8.769	1.240

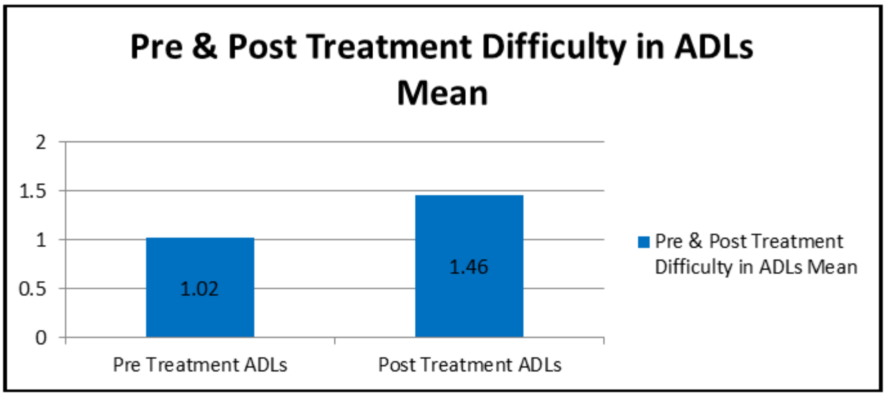


Graph-1: Paired Samples Statistics



Graph-2:

Pre and post treatment pain result showed a decline in pain threshold after treatment with mean difference 0.80, S.D is 1.030.

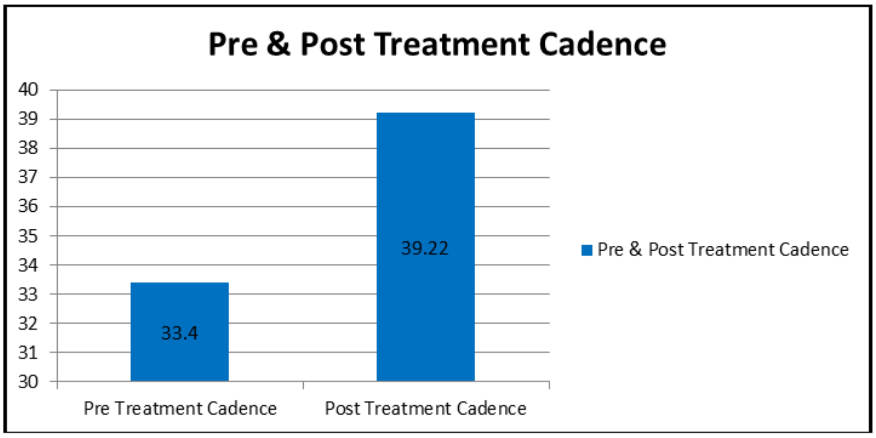


Graph-3:

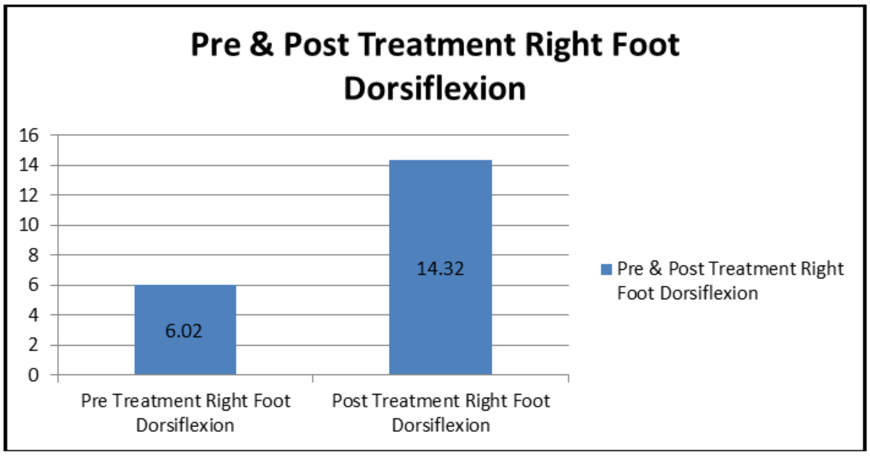
Pre and post treatment difficulty in ADLS result showed improvement in walking after treatment with mean difference 0.440, S.D is 0.501.

Pre and post treatment cadence result showed increase in no of steps taken per minute after treatment with mean difference -5.820, S.D is 5.495.

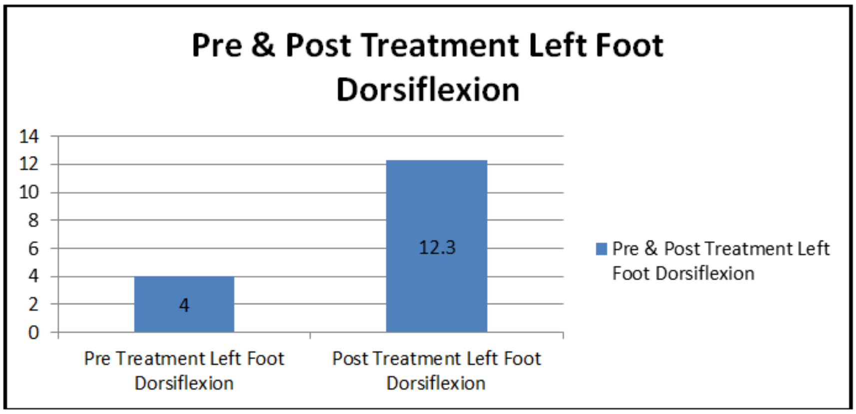
Pre and post treatment result showed an increase in right foot dorsiflexion range after treatment with mean difference -8.300, S.D is 3.340.



Graph-4:



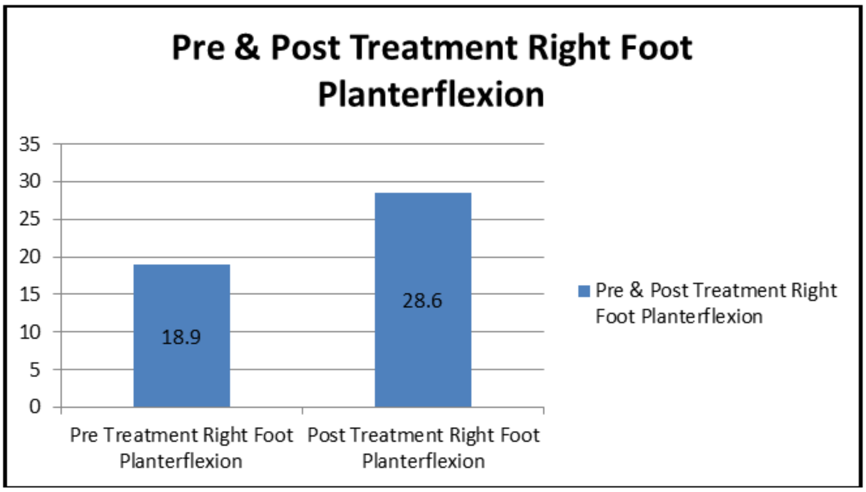
Graph-5:



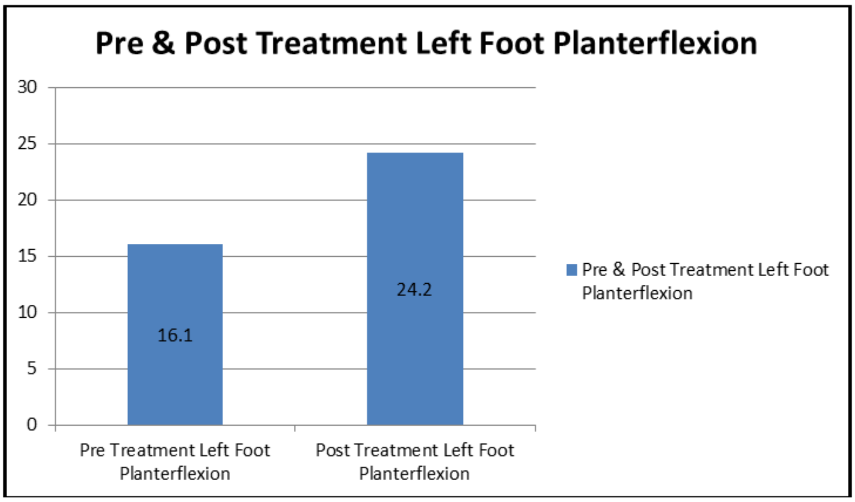
Graph-6:

Pre and post treatment result showed an increase in left foot dorsiflexion range after treatment with mean difference -8.300, S.D is 3.442.

Pre and post treatment result showed an increase in right foor planterflexion after treatment with mean difference -9.700, S.D is 6.578.



Graph-7:



Graph-8:

Pre and post treatment result showed an increase in left foot planterflexion range after treatment with mean difference -8.100, S.D is 3.765.

DISCUSSION

The purpose of this study was to determine whether the effectives of exercise along with application of AFOS have good outcome on improving walking pattern in toe walking children. The results of this study are consistent with our hypothesis that functional walking can be improved with application of AFOS and exercises in children with toe walking.

We started research after reviewing different articles and researches done on effects of exercises, effects of application of AFOS in children with toe walking.

The main emphasis which we were focusing to see the effects were on the variables: cadence, range of motion of ankle Planter flexion and Dorsiflexion and walking. There is decrease in pain scale that is seen on the visual analogue scale. The range of ankle dorsiflexion improved because the flexibility of planter flexors increased therefore allowing the foot dorsiflexion and planter flexion range near to complete range. After achieving a good range of motion at ankle joint, the cadence also improved. In a nut shell there is a remarkable achievement in ankle range of dorsiflexion and planter flexion but there is no significant change in difficulty in walking, because performance of ADLS during walking activities can be helped by these stretching exercises but full recovery pattern in walking needs a long term and sustain treatment.

Delimitations in this study is the child mild to moderate ill health status during therapy (like diarrhea, fever, chest congestion), few patient(C.P child) show noncompliance related to therapy (as they show irritable behavior ,mood swings), less time duration for AFO used by few participants as they were complaining of muscle soreness for few days. If the time duration is increased and sustained then might have chances for early good prognosis. Due to ill health status of few children, the frequency and intensity of exercises were to be limited. Few patients/ children's (C.P child) non-cooperative behavior was also a problem facing situation which can effect the therapy and improvement. As the study showed few limitations and significant results, need to emphasize these factors in future studies and emphasize the inclusion criteria and preventive strategies after reviewing this. In most literatures we reviewed about the use of AFOS are beneficial in cerebral palsy diplegic children. Most of the time type of AFOS plays an important role in achieving better results. The findings of the current study indicate the potential benefits of using rigid AFO-FC with optimal AAAFO and tuning of AFO-FCs. This study emphasizes the need for categorizing children with CP based on their gait patterns when investigating the effects of interventions such as AFOs. Implications for rehabilitation, rigid ankle foot orthoses (AFO) cast at an optimal angle to accommodate the length of gastrocnemius muscle may positively influence walking in children with Cerebral Palsy (CP),tuning of the AFO-Footwear Combination (AFO-FC) has potential benefits to the walking of children with CP, depending on their gait abnormalities, when investigating the effects of interventions such as AFOs, it is important to categorise children with CP based on their gait abnormalities [28].

CONCLUSIONS

Although there has been little research on the use of AFOS with exercises in children with toe walking, the result of this study provides a small but statistically significant increase in ankle dorsiflexion ROM, improvement also seen in no of steps taken by individual after reassessment. However, it is evident and clear whether the change that occurs with exercise and AFOS is clinically important. Therefore exercise and AFOS is recommended where a small increase in ankle range of motion is thought to be benefit. As such no new finding observed in this research except that, some participants complain of mild inflammation and soreness due to stretching of Achilles tendon. Practitioners should consider the early and ongoing use of AFOS along with exercises in the treatment of their patients with toe walking. The application of exercises along with AFOS is non invasive, relatively inexpensive intervention that might be effective in decreasing tightness of calf muscle group, subsequently enhancing range at ankle joint and improve the quality of walking.

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