The Effect of Proiprioceptive Training in Improving Standing Posture in Diaplegic Cerebral Palsy Children

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ABSTRACT

Background: Most children with spastic diplegia have significant weakness in the trunk and spasticity of the extremities as many children with cerebral palsy experience difficulty in processing sensory input and therefore have even greater difficulty in producing a desired output as they have a lack of proprioceptive sensation. Purpose of the study To determine the effect of a proprioceptive stimulation on standing posture in diplegic cerebral-palsied children, Subjects: Thirty diplegic cerebral palsied children of both sexes, their age ranged from three to five years old. They had spasticity graded with 1-1+ according to modified ashowrth scale, and had muscles tightness that can be corrected passively (hip flexors and hamstring - and tendoachilis). In addition to they had ability to stand with support. Materials and Methods For evaluation reflected HVS video camera for recording viewing from lateral side, and Auto CAD analysis program. And for treatment group, the selected physical therapy program (Streching exerxices, Reflex inhibiting patterns, Equilibrium reaction stimulation, strengthing exercises for antgravity muscles) was given to each child in both groups for one hour every session at three times per week every other day, for six months. The study group in addation to programe given to the control group they received proprioceptive stimulation exercises. Results of the study revealed significant improvement in measuring variables of stuy groups when comparing the post treatment mean value after six months with the pre treatment results. Significant improvement was denoted in the study group, when comparing the post treatment mean values (after six months). However, no significant differences were observed when comparing the pre treatment mean values of both groups, in addition to no significant improvement in control group when comparing the post treatment mean value after six months with the pre treatment results Conclusion. It can be concluded that, program can be of help to improve the standing posture in diaplegic cerebral palsy children. Venue: The study was conducted in the Outpatient Clinic, Faculty of Physical Therapy, Cairo University.
Key words: *Diaplegic Cerebral Palsy, Proiprioceptive, Posture, Standing.*

INTRODUCTION

Spastic diplegic children often stand with their legs stiffly extended and adducted. The standing base is narrow and the feet are either in equinus or in eversion position[4]. Molnar, 1985[15] and Bleck, 1987[3] added that The standing and ambulation posture, in the diplegic child, which is initially governed by extensor tone, tends to become more crouched with age. The development ability to stand is essential to the independent performance of other actions such as walking which requires the ability to get into standing. In the diplegic cerebral palsied children, Standing Proprioception is responsible for the sense of position and movement so the proprioceptive stimulation through tranning provides stimulation to the neck, trunk and lower extremities.

Stillman (2002)[20] stated that proprioceptive system has some functions, which are sensory, and others, which are not. The sensory functions, collectively termed Proprioception. Proprioceptive sensations involve awareness of the spatial and mechanical status of the musculoskeletal framework. They include senses of position, movement, stretch, force, weight, pressure, vibration, body segment size and shape and balance. Proprioceptive sensation is also integral to developing motor control when learning new skills. It has its roles in reflex protection of joints against potentially harmful forces and protection of the body against falls.

Lephart and fu (2003)[14] stated that proprioception is a complex entity encompassing several different components, such as the sense of position, velocity, movement detection and force and the afferent signals that give rise to them may have origin in different types of receptors.

Degangi (1990)[8] stated that children with CP may have sensory integrative dysfunction as a result of either neurological dysfunction with the CNS or limitation in sensory experiences resulting from lack of normal motor control, rather than work directly on a functional motor skill, sensory integrative therapy proposes to facilitate the child's organization and processing of proprioceptive, tactile and vestibular input in the CNS to influence postural responses, enviromental awareness, and motor planning.

SUBJECTS, MATERIALS AND METHODS

Subjects

Thirty diplegic cerebral palsied children of both sexes participated in this study, they were selected from Outpatient Clinic, Faculty of Physical Therapy, Cairo University, their age ranged from three to five years old.

They had spasticity graded with 1-1^{+} according to modified ashowrth scale, and had muscles tightness that can be corrected passively (hip flexors and hamstring - and tendoachilis). In addition to they had ability to standing position with support. They were divided randomly into two groups of equal numbers (control and study), each consists of fifteen diplegic cerebral palsied children.

Materials

A- For evaluation

Reflected dots were used to determine the center of the measured joints in the trunk and lower extremities. HVS video camera (Panasonic –Nc– VX size N) was used for viewing each child from lateral side. Sensitive videotapes were used for recording and playing back. Computer analysis by using AutoCAD analysis program.

B- For treatment

Mats, rolls, wedges, medical balls, chairs with different sizes and steps a standing bar and a special standing frame were used for conducting the physical therapy program (Fig. 1).

Fig. (1): A- Chairs with different sizes, B- Standing frame, C- Standing bar and D- Rolls, wedges, and medical balls.

Methods

I. For Evaluation

In current study the trunk and lower limb joints angles were measured for each child .The reflected dots connected by straight lines. The intersected joints between two adjunctive lines were measured and calculated automatically. The trunk measured in relation to the vertical line, hip measured between trunk and thigh, knee measured between the thigh and the leg while the ankle between the leg and dorsum of the foot (In trunk: toward zero position means extension, Hip and knee joints: toward 180 degrees means extension. And ankle joint 90 degrees means vertical position, and > 90 degrees represents plantarflexion and < 90 degrees represents dorsiflexion) (Fig.2).

Fig. (2): The measuring analyzeof the trunk and lower limb joints angles angles.

II. For Treatment

This selected physical therapy program was given to each child in both groups for one hour every session at three times per week (every other day), for six months. This therapeutic program was modified and adapted to each child according to his needs. The standing exercises for both group with ankle foot orhosis or medical shoes according to the case. And Home routine (Instructions were given to each mother to do exercises at home).

Control group

The control group received a selected physical therapy program while as follow:

1. Streching exerxices for hip flexors hamstring and tebliais anterior.
2. Reflex inhibiting patterns for both lower limbs.
3. Equilibrium reaction stimulation from standing.
4. Change postion from supine to side sitting and sitting from prone, quardiped, kneeling, half kneeling, standing to sitting on chair and standing.
5. Active and strengthing exercises for antgravity muscles of lower limb.

Study group

The study group In addition to program given to the control group they received proprioceptive stimulation through the following selected program of exercises.

- Standing holding on Standing bar or sticks.
- Step standing on small wooden steps, with wide base of support then with narrow base.
- Standing With one leg step forword.
- Standing in the corner with and without external support.
- Standing againest wall.
- Standing holding on standing bar or stickes and kiking a ball.
- From standing postion or selfhelp stoop and recovery.
- Standing with manual help and self help on balance board.
- Standing alone with increase the time gradually.
- Gait traning on wedge, on stepper and balance board, adductor separator between the parallel bar.
- Approximation for all joints of the lower limb (hip, knee and ankle) from different angle through the longtudinal axe of the joint from supine and prone.
- Approximation for all joints of the lower limb (hip, knee and ankle) from supine and prone on ball via standing bouncy.
- Standing fram with the both lower limb hold by strapes.
- Static postion (quaderipedal, kneeling, postion, with manual compression on the hip and knee joints.
- Standing with manual support pelvis and knee, bouncing and jumping in the place with manual help.

The follwing abbreiviation use in tratment of the data:

Min. = Minimum   Max. = Maximum   X = Mean
SD= Standard deviation   SE= Standard error
P value = Probability value   Sig. = Significance
NS= Non significant

RESULT

Comapariang the mean values pre treatment of the trunk, hip, knee and ankle angles for both study and control groups In standing posture.there were no significant difference (P>.05).

Table (1): Comparison between the mean values pre treatment of the trunk, hip, knee and ankle angles for both study (s) and control (c) groups.

Item		Min.	Max.	X ± SD	SE	t-test	P value	Sig.
Trunk	Pre-S	24	29	26.33 ± 1.6330	.4216	.490	.0632	NS
	Pre-C	23	31	26.00 ± 2.3299	.6016			
Hip	Pre-S	123	129	126.0667 ± 2.2824	5893	1.451	.169	NS
	Pre-C	124	130	127 ± 2.2039	.5690			
Knee	Pre-S	132	138	134.8667 ± 1.8848	0.4866	0.619	.546	NS
	Pre-C	132	137	134.4667 ± 1.6417	0.4239			
Ankle	Pre-S	105	112	108.0667 ± 2.3135	0.5973	1.2	.250	NS
	Pre-C	107	112	109.00± 1.6475	0.4254			

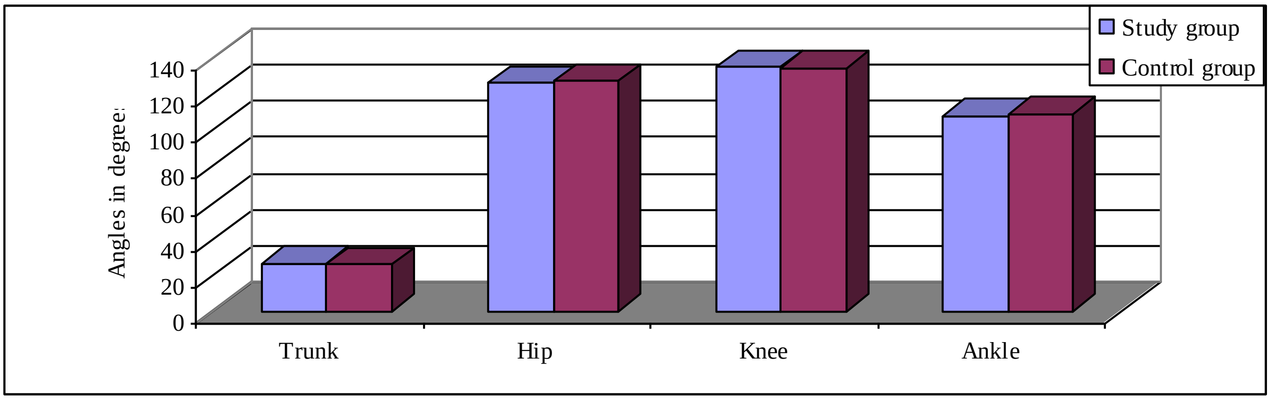

Fig. (3): Comparison between the mean values of the pre treatment trunk hip, knee and ankle angles for both study and control groups.

Comparison between the mean values of trunk, hip, knee and ankle angles pre and post treatment, for the study group the differences were significant (P>.0005).

Table (2): Comparison between the mean values of trunk, hip, knee and ankle angles pre and post treatment, for the study group.

Item		Min.	Max.	X ± SD	SE	t-test	P value	Sig.
Trunk	Pre	24	29	26.3333 ± 1.6330	.4216	.3.287	0.005	S
	Post	21	26	24.6667 ± 1.49601	.3863			
Hip	Pre	123	129	126.0667 ± 1.4960	.5893	3.073	0.008	S
	Post	123	133	129.1333 ± 2.2949	.5925			
Knee	Pre	132	138	134.8667 ± 1.8848	0.4866	3.5	0.004	S
	Post	134	139	136.3333 ± 1.4475	0.3737			
Ankle	Pre	105	112	108.0667 ± 2.3135	0.5973	3.378	0.005	S
	Post	101	110	106.2667 ± 2.5765	0.6652			

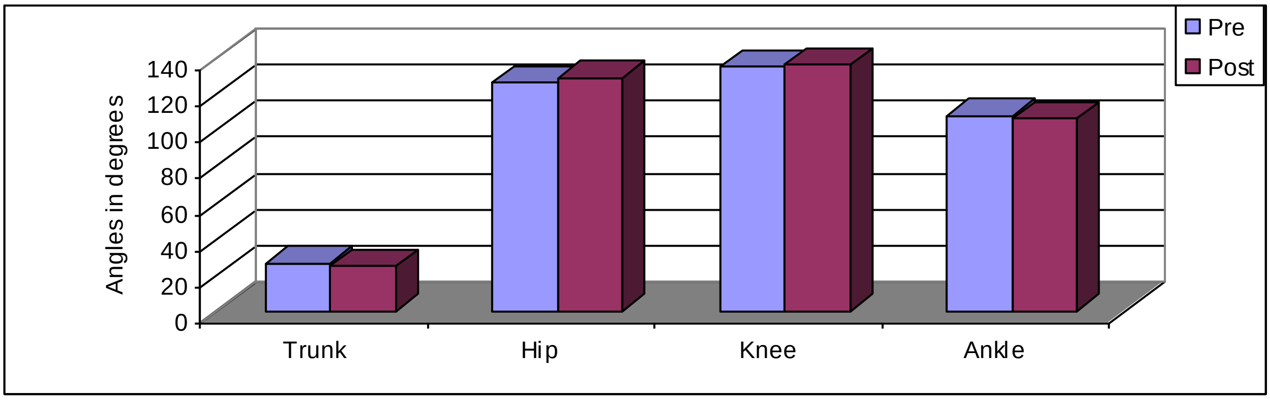

Fig. (4): Comparison between the mean values of the pre treatment trunk hip, knee and ankle angles pre and post treatment, for the study group.

Comparison between the mean values of trunk, hip, knee and ankle angles pre and post treatment for the control group the differences were significant (P>0.05).

Table (3): Comparison between the mean values of trunk, hip, knee and ankle angles pre and post treatment for the Control group.

Item		Min.	Max.	X ± SD	SE	t-test	P value	Sig.
Trunk	Pre	23	31	26.60 ± 2.3299	.6016	1.951	0.169	NS
	Post	22	29	25.5333 ± 1.09952	.5152			
Hip	Pre	124	130	127. ± 2.2039	.5690	.960	0.353	NS
	Post	123	131	127.3333 ± 2.5542	.6595			
Knee	Pre	132	137	134 .4667± 1.6417	0.4239	.892	0.388	NS
	Post	131	139	134.8 ± 1.8205	0.4701			
Ankle	Pre	107	112	109 ± 1.6475	0.4254	1.00	0.334	NS
	Post	105	112	108. 6667 ± 2.4689	0.6375			

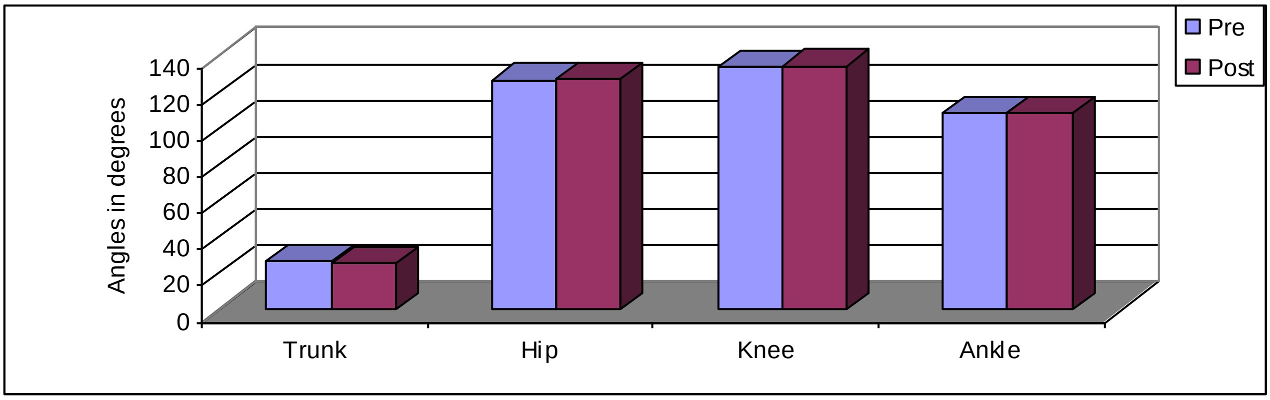

Fig. (5): Comparison between the mean values pre treatment of the trunk hip, knee and ankle angles pre and post treatment for the Control group.

Comparison between the mean values of trunk, hip, knee and ankle angles post treatment for the Study and control group the differences were significant (P>.0005).

Table (4): Comparison between the mean values of trunk, hip , knee and ankle angles , post treatment for the Study and control group.

Item		Min.	Max.	X ± SD	SE	t-test	P value	Sig.
Trunk	Post-S	21	26	24.6667 ± 1.4960	.3863	2.229	0.043	S
	Post-C	22	29	25.5333 ± 1.9952	.5152			
Hip	Post-S	123	133	129.1333 ± 2.2949	0.5925	2.460	0.027	S
	Post-C	123	131	127.3333 ± 2.5542	0.6595			
Knee	Post-S	134	139	136.3333 ± 1.4475	0.3737	2.320	0.036	S
	Post-C	131	139	134.8 ± 1.8205	0.4701			
Ankle	Post-S	101	110	106.2667 ± 2.5762	0.6652	2.605	0.021	S
	Post-C	105	112	108. 6667 ± 2.4689	0.6375			

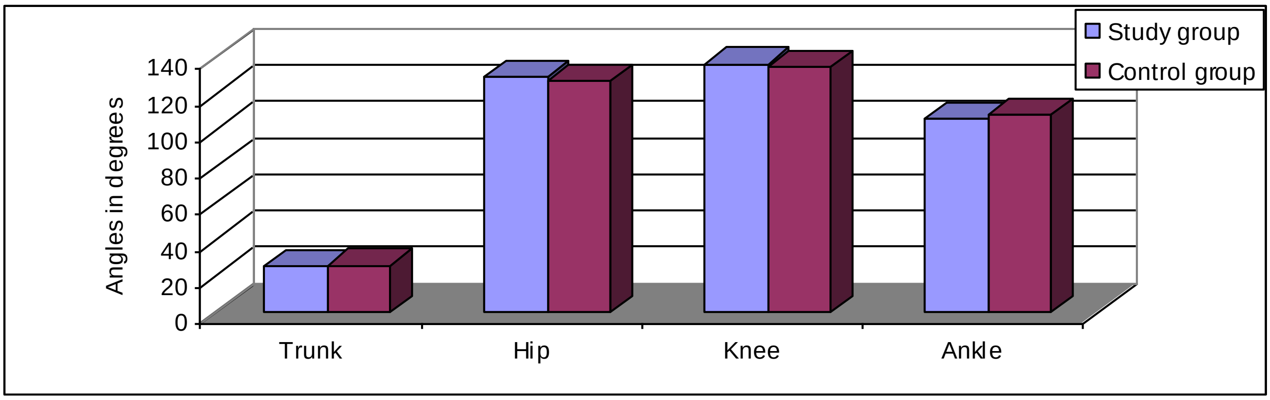

Fig. (6): Comparison between the mean values of the pre treatment trunk hip, knee and ankle angles for post treatment for the Study and control group.

DISCUSSION

Children with CP usually suffers from neurological deficits that interfere with motor function[11]. Such children may show a delay in the acquisition of various motor skills, as, gross and fine motor functions[13]. A diplegic child, may use the arm instead of the leg muscles for postural adjustments in standing by holding on to a firm support[18].

Most children with spastic diplegia have some motor impairment in their upper extremities milder than lower ones. The primary functional problem includes difficulty with mobility and posture. Other problems include postural deviations, including inability to sit without support, inability to stand, and difficulty in movement transitions. Gait is usually crouched because of weakness in the hip and knee extensors, with contractures subsequently developing in flexor groups[17]. Olney and Wright (2000)[16] stated that impairments in CP may be primary or secondary. Functional limitations of the child are often noted in mobility, balance and delays in acquiring motor milestones.

So standing up requires the ability to extend the lower limb joints (Knees and hips) over a fixed base of support (the feet), this ability to use the lower limbs to propel the body mass away from the support surface is an important feature of standing up, needing only the addition of upper body flexion at the hips to bring the body mass forwards at the feet and ability to balance the body throughout the action[7]. The present study was conducted to determine the effect of prioprioceptive stimulation on improving standing posture in diplegic cerebral palsied children aiming to stimulate the sensory system. As there no avalabile published studies.

In the current study the pre treatment results obtained from both groups regarding the inability to assume normal erect standing posture, may be due to abnormalities in the alignment of posture as mentioned by Berger et al., (1984)[2] who reported that abnormal postures affect the structure and function of skeletal muscles in those patients with neurological deficits. And this is also confirmed by Woollacott (1989)[23] who reveled there are some factors affecting the emergence of normal postural control, including changes in the musculoskeletal system (muscle weakness and muscle shortening), lack of sensory, vestibular and visual sensory inputs, lack of adaptive and anticipatory postural mechanisms, and lack of practice which is essential for the built up of the internal representations and perception of action.

The pre treatment results of both groups may be also attributed to musculoskeletal problems as reported by Shumway-Cook (2001)[19], spastic diplegic patients are likely to have neuromuscular impairments like hypertomicity, hyperreflexia, abnormal reflexes, weakness which interfere with the development of proper postural control in addition to changes in the structure and function of the skeletal muscles particularly in the lower extremities. Also he added, inadequate postural reactions (equilibrium and protective reactions). Decreased range of motion limits mobility and decreases the base of support and as a result decreases the efficacy of postural reactions. Thus changes in the musculoskeletal alignment and joint biomechanics can reduce the child's ability to exhibit adequate equilibrium and protective reactions allowing frequent falling from standing in diplegics.

The significant improvement in the post treatment results of the study group may be attributed to the development of proper alignment of posture provided by the different exercises for facilitation of normal erect posture that improved the postural control through appropriate orientation of different body segments[12].

As lack of adequate stability for standing and walking occurs because of impaired postural control and abnormal muscle tone[10], So it can be reporeted that improvement in both groups my be attrputed to the effects of selected exercise program.

The various nerves and sensory receptors are described and classified into types, location, effect, response, distribution and indication. Techniques of stimulation, such as stroking, brushning, tactile, icing, heating, pressure, bone pounding, slow and quick muscle stretch, joint retraction and approximation, muscle contraction are used to activate, facilitate or inhibit motor response[21].

Joint compression of similar body weight or less inhibits hypertonic muscles around joint, thus temporarily assisting the balance of muscle tone at the joint. It is applied through the bone's longitudinal axis[1]. Felden Krais (1977)[9] concept of sensory awareness through movement place emphasis on relaxation of muscle on stretch and distracting and compressing joints for sensory awareness. Both techniques reflect combined proprioceptive techniques. Compression and distraction of joints enhance specific input from a body part while simultaneously facilitating input for a lesser intensity from other body segments. This combined proprioceptive approach enhances body schema awareness in a relaxed environment, these may be clear the improvement in the study group.

Also the improvement in the study group may be explained as proprioceptive input can influence multiple levels of CNS function, and all those levels can potentially modulate the intensity or the importance of that information, through many mechanisms such as pre-synaptic and post synaptic activity, and collateral inhibition[6].

The joint receptors exert strong influences on the motor system and ultimately on musculature. Joint receptors are sensitive to movement, position, traction, compression and palpation[5].

The significant improvement in the study group may also be attributed to that standing with support in a proper alignment. And in the vertical orientation, multiple sensory references are acting, including gravity (vestibular system), the support surface (somatosensory system), and the relationship of the body to objects in the external environment (visual system) as stated by Horak and Macpherson, 2001[12].

The significant improvement in standing posture in the study group may be also attributed to the enhanced proprioceptive sense provided via vestibular stimulation, and spasticity control due to the interaction of vestibular system with other systems. As the control centers in the brain use the signals to develop a subjective awareness of head position in relation to the environment and to produce motor reflexes for equilibrium relating these experiences to those of other sensory systems during standing. The connection with the reticular formation induces increased alertness and awareness, so this interaction of various systems leads to orientation of the child in space as reported by Sveistrup and Woolacott, 1997[22].

The development of proper alignment of posture which minimizes the effect of gravitational forces and maximizes stability with least energy expenditure, it also provides the children enhanced somatosensory feedback about their position in space as state by Shumway-Cook, 2001[19].

Conclusion

It can be concluded that lack of adequate stability for standing occurs because of impaired postural control and abnormal muscle tone, The significant improvement in standing posture in the current study and in particuler to the study group may be attributed to the enhanced proprioceptive function via the special pripprioceptive training programe.

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الملخص العربي

تأثير التدريب علي التقبل الذاتي في تحسين قوام الوقوف عند الأطفال المصابين بالشلل المخي التشنجي

غالبية الأطفال المصابين بالشلل المخي التشنجي لديهم ضعف ملحوظ بالجزع والأطراف ، والعديد من هؤلاء الأطفال يعانوا من خلل في تشغيل مدخلات الإدراك الحسي وبالتالي يكون لديهم صعوبة أكبر في إظهار المخرجات المطلوبة لأنهم يعانوا من نقص في التقبل الذاتي الحسي0 تهدف هذه الدراسة إلى تحديد تأثير تنشيط التقبل الذاتي الحسي علي قوام الوقوف عند الأطفال المصابين بالشلل المخي التشنجي. تم إجراء هذه الدراسة علي 30 طفل من الجنسين تتراوح أعمارهم بين 3-5 سنوات ، درجة التشنج بين 1،+1 درجة بمقياس أشور المعدل ودرجة تزمت العضلات يمكن شدها يدويا، بالإضافة إلى انهم لديهم القدرة علي الوضع واقفا بمساندة0 قسمت عينة البحث إلى مجموعتين . للتقييم تم التصوير بكاميرا الفيديو من المنظر الجانبي مع التحليل باستخدام برنامج أتوكاد . للعلاج استخدم المراتب ، المخروط ، الكرات الطبية ، الكراسي بأحجام مختلفة ومثبت خاص للوقوف : المجموعة الضابطة خضعت لبرنامج التمرينات العلاجية المختارة ومجموعة الدراسة تلقت نفس البرنامج العلاجي للمجموعة الأولى بالإضافة إلى تنبيه الإدراك الحسي ، استمرت التجربة لمدة ستة أشهر بواقع ثلاث جلسات أسبوعيا .

وقد أظهرت الدراسة تحسن ملموس في القياسات المتعددة للمجموعة الدراسة عند المقارنة بين متوسطات قياسات ما بعد ستة أشهر العلاج مع ما قبل العلاج . وقد لوحظ تحسن ملموس في مجموعة الدراسة عن المجموعة الضابطة بعد العلاج، وانه لم يكن هناك اختلاف ملحوظ في قيم القياسات لكلا المجموعتين قبل العلاج وأيضا المجموعة الضابطة عند المقارنة بين متوسطات قياسات ما بعد ستة أشهر العلاج مع ما قبل العلاج . من ذلك نستنتج أن هذا البرنامج يمكن أن يساعد علي تحسين قوام الوقوف عند الأطفال المصابين بالشلل المخي .

الكلمات الدالة : الشلل المخي التشنجي عند الأطفال ، التقبل الذاتي ، قوام الوقوف .