Utilization of Postural Mechanism Facilitation Program for Improving Walking Abilities in Down Syndrome Children

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ABSTRACT

The purpose of this study was to investigate the role of postural mechanism facilitation program on improving certain selected gait parameters in children, suffering from Down syndrome. Twenty Down syndrome children from both sexes, ranging in age from eight to eleven years, represented the sample of this study. They were selected from different residential areas in Cairo. They received a program of remedial exercises for improving righting, equilibrium and protective reactions. Treatment continued for 16 successive weeks, 3 times per week. Evaluation was done before and after the suggested period of treatment, utilizing gait evaluation parameters and the Bruininks-Oseretsky Test of Motor Proficiency Subtest 2 for balance. The results at the end of the treatment period indicated significant improvement in stride length, gait velocity and balance, while a non-significant improvement was detected in cadence. Moreover, a highly significant difference was recorded in balance. Such a difference may be attributed to the enhancing effect of the postural mechanism facilitation program on facilitating voluntary motor control that leads to

INTRODUCTION

Down syndrome is the most common chromosomal cause of moderate to severe mental defect, caused mainly by a whole or partial trisomal defect of chromosome 21[14]. Its incidence is about 1 800 live births and is equally distributed between sex[16]. Mental retardation was clearly manifested in those patients, which ranges from moderate to severe. On the other hand, most Down syndrome patients are considered trainable rather than educable[13].

The major factor in the production of Down syndrome was proven to be late maternal age . The average maternal age at birth of a Down syndrome child is about 34 years[18]. Unfortunately, the correlation of late maternal age and the factors causing Down syndrome is still unknown. It may be attributed to the effect of age on the process of myosis. Alfi et al (1980)[1] concluded other less important factors, which may contribute to the occurrence of Down syndrome. They are pregnancy spacing, exposure to adverse environmental factors, medication during pregnancy, paternal age, oral contraceptives and gene mutations. Generally, infants with Down syndrome are hypotonic, demonstrating a delay in achieving gross motor milestones, such as sitting, standing and walking in addition to retarded development of postural reactions. Such a delay can be attributed to many problems, the most important of which

are ligamentous laxity, decreased strength and hypotonia[9].

The postural reactions (righting, equilibrium and protective reactions) are the intrinsic part of motor skills. They are identified as the underlying responses, related to motor milestones. The postural reactions provide automatic support and stability to the head, trunk and extremities and facilitate normal weight shifts and mobility[9]. When these reactions are absent, abnormal motor skills develop[12].

When motor development of the Down syndrome child is compared with that of a developmentally normal child, a consistent delay is observed in the acquisition of both postural and voluntary components of voluntary control[8]. Davis and Kelso (1982)[6] examined the gross motor skills in Down syndrome children. They confirmed that those children performed consistently below their normal peers. Neuromuscular abnormalities in children with Down syndrome include persistence of primitive reflexes beyond their normal disappearance time. Moreover, generalized hypotonia is also clear, which, in its turn, affects joint range of motion, leading to an unusual posture frog-like position [4]. Dichter et al., (1993)[7] attributed hypotonia to decreased segmental motor neuron pool excitability and pathology of the stretch reflex mechanism.

Aim of the study:

To evaluate the role of a postural mechanism facilitation program on improving selected gait parameters in Down syndrome children.

SUBJECTS, MATERIALS AND METHODS

Subjects:

The present study included twenty young volunteer children from both sexes, ranging in age from 8 to 11 years. They were suffering from Down syndrome. All of them were pupils in the primary school, belonging to different socio-

children selected met the following basic criteria:

1- Severe degree of mental retardation.
2- An IQ between 40 and 45, as estimated by a psychiatrist.
3- Having no other illnesses that might interfere with the treatment program, such as hearing loss, cardiac anomalies or hip dislocation, according to medical examination by a physician.
4- Having a delay in postural reactions, as revealed by physical examination.
5- Sufficient cognition should be demonstrated to understand the requirements of the study.

Materials:

a) Walking sheet: 10 meters long, divided at 1-cm intervals.
b) Recording and displaying system:
   1. Video set, camera and tapes.
   2. Colour TV.
   3. Stop watch.
c) Tape measure.
d) The Bruininks-Oseretsky Test of Motor Proficiency Subtest 2 for Balance (Form1).

Form (1): The Bruininks-Oseretsky Test of Motor Proficiency Subtest 2 for Balance.

Action		Point Score		Total Score
		Trial 1	Trial 2	
Standing on preferred leg on floor	10 seconds maximum per trial	( ) seconds 0 1 2 3 4	( ) seconds 0 1 2 3 4	
Standing on preferred leg on balance beam	10 seconds maximum per trial	( ) seconds 0 1 2 3 4 5 6	( ) seconds 0 1 2 3 4 5 6	
Standing on preferred leg on balance beam-Eyes closed	10 seconds maximum per trial	( ) seconds 0 1 2 3 4 5 6 7	( ) seconds 0 1 2 3 4 5 6 7	
Walking forward on walking line	6 steps maximum per trial	( ) steps 0 1 2 3	( ) steps 0 1 2 3	
Walking forward on balance beam	6 steps maximum per trial	( ) steps 0 1 2 3 4	( ) steps 0 1 2 3 4	
Walking forward heel-to-toe on walking line	6 steps maximum per trial	( ) steps 0 1 2 3	( ) steps 0 1 2 3	
Walking forward heel-to-toe on balance beam	6 steps maximum per trial	( ) steps 0 1 2 3 4	( ) steps 0 1 2 3 4	
Stepping over response speed Stick on balance beam	10 seconds maximum per trial	0 1	0 1	

Adapted from Bruininks (1987)[3]

Methods:

For evaluation:

Gait evaluation:

The walking sheet was positioned on the floor of the gait evaluation area and fastened on both sides. The subjects were instructed to walk as normally as they used to, from the start to the end of the walkway. This was repeated three successive times. Then, the subjects were videotaped along the ten-meter long of the sheet. The videotape was then played back on the TV for the measurement of the temporal and distance gait parameters, as follows:

* Stride length: The distance between two successive placement of the same foot.
* Cadence: The number of steps taken per minute.
* Velocity: The distance covered in a minute. (Whittle, 1993)[22]

Balance evaluation:

Balance was examined, using the Bruininks-Oseretsky Test of Motor Proficiency Subtest 2 for Balance[3]. Each test was repeated for two times, after which the final score was calculated.

Evaluation procedures were done for all patients before and after the suggested period of treatment

For treatment:

A postural mechanism facilitation program (righting, equilibrium and protective reactions) (Levitt, 1982) [12] was applied for all patients. This program comprised exercises for:

- Antigravity mechanism (to support body weight against gravity).
- Postural fixation of the parts of the body (to improve stability).
- Counterpoising mechanisms (to maintain balance during motion).

- Righting reactions (to improve rising into position as well as returning to the original position).
- Tilt reaction (to maintain balance).
- Reactions to falling (to save from falling).

Each session lasted about 60 minutes, interrupted by rest intervals. Treatment of all patients continued for 16 successive weeks, 3 sessions per week.

RESULTS

The results collected from the present study were statistically analyzed to obtain the mean, standard deviation (SD) and mean difference (MD). The paired t-test was utilized to compare between means and hence, to test the significance of such results.

As shown in table (1), the mean value of the stride length before treatment was 52.2 ± 5.745 cm, which increased after the suggested period of treatment to 61.5 ± 7.134 cm. The percentage of improvement was 9.3 %, which revealed a highly significant difference ($t = 3.7061$, $p < 0.01$) (Fig.1).

Table (1): Shows mean values of stride length (in cm) in all patients before and after treatment.

Comparison	Pre	Post
Mean	52.2	61.5
SD	± 5.745	± 7.134
MD	+ 9.3	
% of Change	+ 17.82 %	
t	3.7061	
P	< 0.01 S.	

Concerning cadence, in table (2) it can be revealed that the cadence increased from 77.055 ± 7.740 steps/min before starting the treatment program, to 77.155 ± 9.572 steps/min after the application of the postural reaction facilitation program. The percentage of improvement was 0.13%, which showed a non-significant change ($t = 0.0894$, $p > 0.05$) (Fig. 1).

Table (2): Shows mean values of cadence (in steps/min) in all patients before and after treatment.

Comparison	Pre	Post
Mean	77.055	77.155
SD	± 7.740	± 9.572
MD	+ 0.1	
% of Change	0.13 %	
t	0.0894	
P	> 0.05 N.S.	

The results of the velocity are represented in table (3). Before the start of the treatment program, the velocity was 37.25 ± 4.442 cm/sec, which increased after 16 weeks of treatment to 38.49 ± 4.022 cm/sec, with a percentage of improvement of 3.33%. A highly significant improvement was recorded ($t = 3.4150$, $p < 0.01$) (Fig. 1).

Table (3): Shows mean values of velocity (in cm/sec) in all patients before and after treatment.

Comparison	Pre	Post
Mean	37.25	38.49
SD	± 4.442	± 4.022
MD	+ 1.24	
% of Change	+ 3.33 %	
t	3.4150	
P	< 0.01 S.	

As revealed from table (4), the total score obtained from Bruininks-Oseretsky Test before treatment was 15.85 ± 2.231, which underwent an increase after the suggested period of training to be 17.10 ± 3.73. The percentage of change was 7.06 %, which was statistically very highly significant ($t = 4.5910$, $p < 0.001$) (Fig. 1).

Table (4): Shows mean values of Bruininks-Oseretsky Test of Motor Proficiency (in grades) in all patients before and after treatment.

Comparison	Pre	Post
Mean	15.58	17.10
SD	± 2.231	± 3.73
MD	+ 1.1	
% of Change	+ 7.06 %	
t	4.5910	
P	< 0.001 S.	

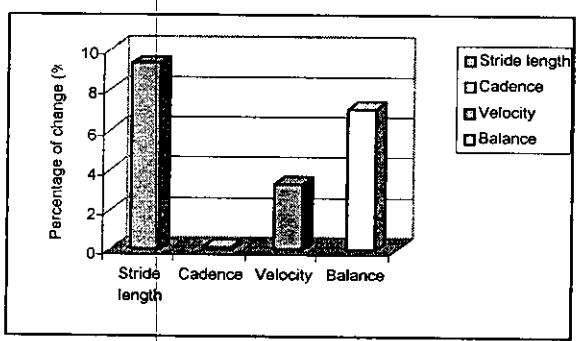

Fig. (1): Shows the percentage of change in mean values of gait parameters and stability in all patients.

DISCUSSION

Investigators have determined that infants with Down syndrome show delays in achieving gross motor milestones (events), such as sitting, standing and walking. It was reported that those children, whose mean age was 12 years, had difficulty with static balance[11]. In 1981, Henderson et al.,[10] added that those children, who were between 7 and 14 years of age, had a defect in agility and balance tasks, when compared with normal peers. Postural responses to loss of balance were found to be slow in young children, between 1 and 6 years of life, with Down syndrome, which leads to insufficient stability (Shumway-Cook and Woollacott, 1985)[15]. Haley (1986)[9] found an association between delays in achieving gross motor milestones and delays in the development of postural mechanism in infants with Down syndrome.

The postural reactions (righting, equilibrium and protective reactions) have been considered to be related, most functionally to motor milestones (events). They provide automatic support and stability to the head, trunk and extremities. Moreover, postural reactions help to facilitate normal weight shifting and mobility (Haley, 1986)[9].

The utilization of early intervention programs on the developmental skills of children with Down syndrome has been of interest for a number of years. These programs focus on the stimulation of developmental skills in the child, in addition to the facilitation of parent-child interaction (Connolly et al., 1993)[5].

Children with many types of motor dysfunction have problems maintaining postural stability. Because maintenance of postural stability is an integral part of all movements, these patients should be evaluated thoroughly and treated accordingly to improve their postural stability. Relatively few measurements of postural stability in children are available that have acceptable reliability and validity documentation, among which, is the Bruininks Oseretsky Test of Motor Proficiency (Westcott et al., 1997)[21].

In the present study, the balance tasks have been evaluated among Down syndrome children. Furthermore, the deviations in some selected gait parameters were also evaluated to determine the effect of postural reaction facilitation program on them. The data collected from this study indicated that the use of postural mechanism facilitation technique has played an important role in improving balance in children suffering from Down syndrome which, in turn, leads to an improvement in the selected gait parameters.

The results of this work came in agreement with those of Sutherland and Davis (1993)[17], who stated that in order to walk normally, balance should be maintained, either statically or dynamically during single leg stance. They added that sufficient power must be also provided to make the necessary limb movements.

The results also coincide with the results reported by Whittle (1993)[22], who postulated that the failure of Down syndrome children to achieve normal walking might be as a result of their failure to maintain their balance freely. Moreover, they lack the sufficient power to maintain their stability.

Our results are also supported by those of Connolly et al (1993)[5], who stated that the postural mechanism facilitation program could be used to improve the quality of life of handicapped children, who have poor postural reactions. They confirmed that children with Down syndrome, who were involved in early intervention programs had significantly higher scores on measures of intellectual and adaptive functions than did patients of comparable ages, who did not participate in a similar programs.

The results of this work were in agreement with those of Unrau, et al (1994)[20], who announced that standing from a supine position is important for physical independence. Additionally, identifying appropriate standing movements in persons with Down syndrome necessitates weighing numerous intrinsic factors (physiological and anthropometric factors) other than motor maturity.

The results obtained from the present study agreed also with the results of Ulrich et al (1995)[19]. In their study, the investigators used a dynamic systems strategy to examine longitudinally the ability of infants with Down syndrome to produce alternating steps, when supported on a motorized treadmill. The results proved the usefulness of dynamic systems theory in understanding delayed development and the possibilities of pursuing the treadmill paradigm as an intervention approach.

The results also were identical to those reported by Amin et al (1997)[2], who found a significant improvement in gait parameters and level of balance. They utilized an early intervention program for 3 months in management of Down syndrome children. The only difference observed between both results was in the degree of significance of these results.

The improvement in Down syndrome children may be due to the role of the early intervention programs in the facilitation of the control of different body parts in the upright position. Moreover, the postural mechanism facilitation program might improve muscle tone, muscle strength and endurance. Neurophysiologically, the treatment program might have an effect on modulating discharge to neural connections of the motor cortex, leading to improved coordination and mental concentration. This, in its turn, has modulated the input from the pyramidal system, improved cerebellar function and later, improve automatic reactions.

CONCLUSION

From the obtained results, it can be concluded that the postural mechanism facilitation program has a great effect on Down syndrome children. Although they still have certain defects in the area of motor skill being evaluated, but the balance as well as the walking pattern has been significantly improved.

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الملخص العربي

استخدام برنامج تمرينات التحكم في رد فعل القوام لتحسين الاتزان و طريقة المشي عند الأطفال المصابين بمرض "داون"

الهـدف من الدراسة هو محاولة تحليل وتقويم الانحرافات في قياسات المشي عند الأطفال المصابين بمرض "داون" بالإضافة إلى تقويم تأثير تمرينات التحكم في رد فعل القوام علي أنموذج المشي والاتزان لدى الأطفال المنغوليين .

اشتمل البحث على عشرين طفلا من الجنسين (٩ من الذكور، ١١ من الإناث)، ممن تراوحت أعمارهم بين ٨ و ١١ عاما، وقد تم اختيارهم طبقا لبعض المعايير الأساسية، و قد تم تحديد قياسات المشي عند جميع الأطفال قبل وبعد العلاج والتي اشتملت على: طول الخطوتين المتتاليتين، عدد الخطوات في الدقيقة، و سرعة المشي، بالإضافة إلى اختبار بروينزكس-أوسيرتسكي (الجزء الخاص بالتوازن)، استمر العلاج بواسطة برنامج لتمرينات التحكم لمدة ستة عشرة أسبوعا بواقع ثلاثة جلسات أسبوعيا .

أظهرت نتائج البحث وجود فروق ذات دلالة إحصائية بعد انتهاء فترة العلاج فقد تحسن طول الخطوتين المتتاليتين، وكذلك سرعة المشي لدى الأطفال المنغوليين تحسنا ذا دلالة إحصائية عالية بالمقارنة بالنتائج المدونة قبل العلاج، وان كان هذا التحسن أقل من القياسات الطبيعية المأخوذة من الأطفال الطبيعيين، أما بالنسبة لعدد الخطوات في الدقيقة فقد تحسن تحسنا طفيفا ليس له أي دلالة إحصائية، هذا بالإضافة إلى وجود فروق ذات دلالة إحصائية عالية جدا بين نتائج المجموعة قبل و بعد انتهاء فترة العلاج من حيث التوازن. وطبقا لهذه النتائج فانه يوصى باستخدام برنامج تمرينات التحكم في رد فعل القوام في علاج الأطفال المصابين بمرض "داون" ..