

Original Article

Effectiveness of therapeutic physical exercises in cases of dyskinetic cerebral palsy

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Published online: March 31, 2012

(Accepted for publication March 15 2012)

Abstract:

We have studied characteristic features of movements of children with motoristic disturbances. In cases when anomalous development results in the development of anomalous postures and movements, this in its own way causes fixation in the given segment, the movement of which becomes difficult. As a result of the research we have concluded that appropriately selected physical exercises decrease the cases of movement fixation and the development of anomalous patterns. Regular and adequate physical exercises are effective in cases of dyskinetic cerebral palsy and early intervention greatly improves functional independence of children with dyskinetic cerebral palsy.

Our research objective was to define the effectiveness of regular therapeutic exercises (physical therapy) in cases of Dyskinetic Cerebral Palsy.

The research was carried out in the Medical and Educational Center of Children Neurology and Neurorehabilitation of Tbilisi; the target of the research were 8 children with Dyskinetic Cerebral Palsy who underwent Graded Exercise Therapy (GET). We used GMFM scale for gross motor function assessment. The observation was going on during 5 years. Results of treatment with physical exercises were improved by 16.8 percent after one year, by 30.1 percent, after two years, by 36.9 percent after three years, by 44.5 percent after four years, and by 54.7 percent after five years, in comparison with the initial results (10.6 percent). As a result of the research it was concluded that appropriately selected therapeutic exercises improve motor skills and functional independence of children with dyskinetic cerebral palsy.

Key words: 1. pattern - model 2. proximal – close to trunk 3. Distal – far from trunk 4. Postural – posture 5. GMFM (Gross Motor Function Measure) – gross motor function assessment 6. S-P turning from pronation to supination 7. P-S turning from supination to pronation.

Introduction:

It is a well-known fact that child development is a complex process and includes sensor and motor development; this development goes in cephalocaudal direction, from proximal to distal, from gross movements to minor movements etc. Early treatment is particularly essential for children with cerebral palsy. This treatment should start at the stage of infancy (3-4 months). During this stage adaptive and plastic skills are developed in an infant brain. As it is known, toddler development during first 18 months goes on rapidly. This is the best period not only for learning, but also for adapting to limited abilities. In most cases treatment at early age results in better results in a short period, as toddlers at this stage do not have many of anomalous patterns developed and they become evident at later stages. In this point of view, mother training is also very essential, so that the toddler can make normal movements. [1, 2] Cause of anomalous development is a formation of the so-called blocks and compensative movements developed as a result of these blocks that furtherly results in harder anomalous development [6]. Having certain balance between bending and stretching muscle movements, is essential for overcoming gravitation power and keeping postural ton [4]. In case of losing this balance it is difficult for child to make movements and keep appropriate posture at the same time. [3, 9].

Athetosis, chorea and dystonia are clinically apparent to dyskinetic cerebral palsy. Athetosis is characterised by slow, transitional athetotic movements in distal muscles by dyssynergia of antagonist muscles. Anomalous movements become more intensive or cause changes in emotions, postures or aimed movements; they are characterized by impediments in reverse development of simple reflexes, with face grimace and oropharyngeal difficulties [5, 7]. Choreic movements are faster, and irregular; they are connected with face, bulbar muscles and basically, muscles of proximal group. Chorea becomes more severe in cases of excitement and fever; ballism may also be symptomatic to chorea. Dystonia is characterized with trunk and limbs abnormal postures. In cases of dyskinetic cerebral palsy muscles tone is changing. This may be characterized with hypotonia at the age of infancy; if hypotonia is changed by hypertonia later on it is mainly characterized by

“tension” that decreases during relaxation or change of posture. “Tension” is a sudden involuntary hypertonia in bending as well as stretching muscles; in cases of voluntary movements limbs become stiff. Deep reflexes are normal or provoked rarely; there is no clonus and plantar answer; dyskinetic cerebral palsy is characterized with several simultaneous involuntary movements [6, 4]. Though, mainly it is divided into athetosis and dystonia types; athetosis is characterized by chorial, athetoid or both types of movements; muscle tone is normal or hypotonic and mainly dystonic; in cases of dystonia, “tension” and newborn strong reflexes predominance, it is important to consider the following factors while selecting physical therapy [8, 7]:

1. Appropriately selected physical exercises are essential
2. It is necessary to apply therapeutic exercises in cases of dyskinetic cerebral palsy
3. It is important that exercises are challenging, so that they are interesting and give some stimuli to child
4. There are no dystonic spasms
5. Achieving symmetric posture of the whole trunk
6. As proximal mobility is increased it is essential to decrease mobility

Materials and Methods:

The research was carried out at the Medical and Educational Center of Children Neurology and Neurorehabilitation of Tbilisi. All children under observation had dyskinetic cerebral palsy. Their conditions were evaluated by neurologist who made diagnosis and determined the severity level of cerebral palsy. These children underwent specific graded exercise therapy developed by us, in accordance with the severity of illness. And parents were advised on recommended exercises that could be applied at home conditions. We carried observations during 5 years. At every stage of observation we made motor assessment, by using GMFM scale and evaluated children’s following skills:

- head control
- turning around
- sitting/sitting up
- standing in crawling position and moving around
- standing on knees and moving around
- standing up/standing
- walking

The treatment included four courses of medical treatment and every course included 20 procedures.

Results and conclusions:

The group we selected involved eight children who started medical treatment from the first 4 months and underwent it during 5 years. year of their lives. For having group homogeneity we selected children with mild dyskinetic cerebral palsy.

Table # 1 shows eight patients’ gross motor skills: head control - holding up the head, turning around (from supination to pronation), physical exercises according to sitting and sitting up positions on initial (I) stage, after one year (II) and two years (III). “+” means “is able to do”, “-“ means “is not able to do”.

Table I: Research Target Group Motor Skills (head control, turning around, sitting and sitting up)

Skills			1	2	3	4	5	6	7	8	
Head control		I	+	+	+	+	+	+	+	+	
		II	+	+	+	+	+	+	+	+	
		III	+	+	+	+	+	+	+	+	+
Turning around	S-P	I	---	---	---	---	---	---	---	---	
		II	---	+	+	+	+	---	---	+	
		III	+	+	+	+	+	+	+	+	+
	P-S	I	---	---	---	---	---	---	---	---	---
		II	---	+	+	+	---	+	+	---	---
		III	+	+	+	+	+	+	+	+	+
Sitting	On floor	I	---	---	---	---	---	---	---	---	
		II	---	+	+	---	+	---	---	---	
		III	+	+	+	+	+	+	---	+	
	On chair	I	---	---	---	---	---	---	---	---	---
		II	---	---	---	---	---	---	+	---	---
		III	+	+	+	+	+	+	---	+	---
	Side-sitting	I	---	---	---	---	---	---	---	---	---
		II	---	---	---	---	---	---	---	---	---
		III	---	---	---	+	---	---	---	+	---

	With support	I	---	---	---	---	---	---	---	
		II	+	+	+	+	+	+	---	+
		III	+	+	+	+	+	+	+	+
Sitting up	With support	I	---	---	---	---	---	---	---	---
		II	---	+	---	---	---	---	---	---
		III	---	+	+	+	---	---	+	+
	With pronation	I	---	---	---	---	---	---	---	---
		II	---	---	---	---	---	---	---	---
		III	---	+	+	+	---	+	+	---

As is it seen from the Table, all the eight patients **had a skill of head controlling** at the very initial stage of exercises and during two years, as for the skill of accomplishing **turning around movements** from supination to pronation and vice versa, neither of patients were able to make at the initial stage of exercises. After one year of exercising 62.5 percent of children were able to make turning around movements from supination to pronation and 62.5 percent accomplished the same movements from pronation to supination. After two years of physical therapy all the patients were able to accomplish turning around movements. According to the data about the skill of **sitting on floor**, neither of the target group members was able to do this at the initial stage of exercises. After one year of physical therapy, 37.5 percent and 87.5 percent of patients after two years of physical therapy could accomplish this movement. As for the skill of **sitting on chair, side-sitting and sitting with support**, neither of patients had these skills at the initial stage; after one year of exercising 12.5 percent of patients developed this skill of sitting on chair; neither of patients had a skill of side-sitting, 87.5 percent of patients developed the skill of sitting with support. As for the results of exercising during two years, 75.1 percent of patients could sit on chair, 87.5 percent of patients were able to sit with support and only 25.1 percent improved the skill of side-sitting. **Sitting-up** movement seemed to be the hardest one. This was reflected in the following facts: only 62.5 percent of patients could develop the skill of sitting-up **with support**, only after two years of practicing period; as for the sitting up **with proning**, this skill was improved by 12.5 percent in one-year period of physical therapy and by 62.5 percent after two-year's therapy. In the Table # 2 we present gross motor skills of eight patients: head control, turning around (from supination to pronation), sitting and sitting-up skills after three years (IV), four years (V) and five years (VI). "+" means "is able to do", "--" means "is not able to do".

Table II: Research Target Group Motor Skills (head control, turning around, sitting and sitting-up)

Skills		1	2	3	4	5	6	7	8	
Head control	IV	+	+	+	+	+	+	+	+	
	V	+	+	+	+	+	+	+	+	
	VI	+	+	+	+	+	+	+	+	
Turning around	S-P	IV	+	+	+	+	+	+	+	
		V	+	+	+	+	+	+	+	
		VI	+	+	+	+	+	+	+	
	P-S	IV	+	+	+	+	+	+	+	
		V	+	+	+	+	+	+	+	
		VI	+	+	+	+	+	+	+	
Sitting	On floor	IV	+	+	+	+	+	+	+	
		V	+	+	+	+	+	+	+	
		VI	+	+	+	+	+	+	+	
	On chair	IV	+	+	+	+	+	+	+	
		V	+	+	+	+	+	+	+	
		VI	+	+	+	+	+	+	+	
	Side-sitting	IV	---	---	+	+	---	+	+	+
		V	---	---	+	+	---	+	+	+
		VI	---	---	+	+	---	+	+	+
	With support	IV	+	+	+	+	+	+	+	+
		V	+	+	+	+	+	+	+	+
		VI	+	+	+	+	+	+	+	+
Sitting-up	With support	IV	---	+	+	+	---	+	+	+
		V	---	+	+	+	---	+	+	+
		VI	---	+	+	+	---	+	+	+
	With pronation	IV	---	+	+	+	---	+	+	+
		V	---	+	+	+	---	+	+	+
		VI	---	+	+	+	+	+	+	---

The Table # 2 shows results of head control, skills of turning around and sitting on floor, sitting on floor with support and sitting on chair that was accomplished by every member of the group. As for the skill of side-sitting, 62.5 percent of patients developed the skill after three years and they remained the same after four and five years of physical therapy.

In Table # 3 we present results regarding the skills of standing in crawling position and moving around. The markers are the same as in the Table # 1.

At the initial stage and after one year of physical therapy neither of patients had a skill of **standing in crawling position**; 62.5 percent of patients developed this skill, after two years of physical therapy. Neither of patients became able to move around in a crawling position in a **reciprocal** manner. 62.5 percent of patients became able to move around in an irreciprocal manner after two years of physical therapy. There were no improvements regarding the skill of **standing on knees** and moving around in this position.

Table III: Research Target Group Motor Skills (standing in crawling position, standing on knees and moving around)

Skills		1	2	3	4	5	6	7	8	
Standing in crawling position and moving around	Standing	I	---	---	---	---	---	--	--	--
		II	---	---	---	---	---	-	-	-
		III	---	+	+	+	---	-	+	+
	In an reciprocal manner	I	---	---	---	---	---	-	-	-
		II	---	---	---	---	---	-	-	-
		III	---	---	---	---	---	-	-	-
	In an irreciprocal manner	I	---	---	---	---	---	-	-	-
		II	---	---	---	---	---	-	-	-
		III	+	+	+	+	---	+	-	-
Standing on knees and moving around	I	---	---	---	---	---	-	-	-	
	II	---	---	---	---	---	-	-	-	
	III	---	---	---	---	---	-	-	-	

In Table # 4 we present results regarding the skills of standing in crawling position and moving around, and standing on knees and moving around. The markers are the same as in the Table # 2.

Table IV: Research Target Group Motor Skills (standing in crawling position, standing on knees and moving around)

Skills		1	2	3	4	5	6	7	8	
Standing in crawling position and moving around	Standing	IV	---	+	+	+	---	--	+	+
		V	---	+	+	+	---	-	+	+
		VI	---	+	+	+	---	-	+	+
	In an reciprocal manner	IV	---	---	---	---	---	-	-	-
		V	---	---	---	---	---	-	-	-
		VI	---	---	---	---	---	-	-	-
	In an irreciprocal manner	IV	+	+	+	+	---	+	-	+
		V	+	+	+	+	+	+	-	+

		VI	+	+	+	+	+	+	-	+
Standing on knees and moving around		IV	---	---	---	---	---	---	---	---
		V	---	---	---	+	---	---	---	---
		VI	---	---	---	+	---	---	---	---

As it has become obvious, skill of **standing in a crawling position** was improved to 62.5 percent, after three years of practice and these results remained the same after four and five years. Neither of patients could improve the skill of moving around in a crawling position in a **reciprocal** manner. Improvements were made regarding the skill of moving around in an **irreciprocal** manner after three years' of physical therapy. 75.1 percent of patients accomplished it; these results were improved by 87.5 percent after four years and remained the same after 5 years period of exercising.

Table # 5 presents results regarding the skills of standing in crawling position and moving around, and standing on knees and moving around. The markers are the same as in the Table # 1.

Table V: Research Target Group Motor Skills (standing up, standing and walking)

Skills			1	2	3	4	5	6	7	8
Standing up	By putting one leg forward	I	---	---	---	---	---	---	---	---
		II	---	---	---	---	---	---	---	---
		III	---	---	---	---	---	---	---	---
	From bear position	I	---	---	---	---	---	---	---	---
		II	---	---	---	---	---	---	---	---
		III	+	+	+	+	---	---	+	+
	With support	I	---	---	---	---	---	---	---	---
		II	---	+	---	---	---	---	+	---
		III	+	+	+	+	+	---	+	+
Standing	With support	I	---	---	---	---	---	---	---	
		II	---	+	---	---	---	+	+	
		III	+	+	+	+	+	---	+	
	Independently	I	---	---	---	---	---	---	---	
		II	---	---	---	---	---	---	---	
		III	---	+	+	+	---	+	+	
Walking	With support	I	---	---	---	---	---	---	---	
		II	---	---	---	---	---	---	---	
		III	+	+	+	+	+	---	+	
	Independently	I	---	---	---	---	---	---	---	
		II	---	---	---	---	---	---	---	
		III	---	+	+	+	---	+	+	
	With supporting means	I	---	---	---	---	---	---	---	
		II	---	+	+	+	---	+	+	
		III	+	+	+	+	+	+	+	

As it has become obvious **standing up by putting one leg forward** and **standing up from bear position** had no effect by the end of the initial stage. The skill of standing up from bear's position was improved by 75.1 percent after two year's practice. 25.1 percent of patients improved the skill of **standing up with support**, after one year of exercising and these results were improved to 87.5 percent at the third stage.

Neither of patients had a skill of **standing with supporting means** at the very beginning. By the end of the initial stage these results were improved to 37.5 percent, and to 87.5 percent at the second stage. 62.5 percent of patients became able to **stand independently**, only after two years' practice.

Neither of patients had a skill of **walking** at the very beginning. By the end of the first stage 87.5 percent of patients could walk with support and by the end of the second stage all members of the group developed the skill of walking **by supporting means**. Only 62.5 percent of patients could **walk independently** by the end of 2 years practice period.

Table # 6 presents results regarding the skills of standing up, standing and walking; the other markers are the same as in the Table # 2.

Table VI: Research Target Group Motor Skills (standing up, standing and walking)

Skills		1	2	3	4	5	6	7	8	
Standing up	By putting one leg forward	IV	---	---	---	---	---	---	---	
		V	---	---	---	---	---	---	---	
		VI	---	---	---	---	---	---	---	
	From bear position	IV	+	+	+	+	---	---	+	+
		V	+	+	+	+	---	+	+	+
		VI	+	+	+	+	+	+	+	+
	With support	IV	+	+	+	+	+	+	+	+
		V	+	+	+	+	+	+	+	+
		VI	+	+	+	+	+	+	+	+
Standing	With support	IV	+	+	+	+	+	---	+	+
		V	+	+	+	+	+	+	+	+
		VI	+	+	+	+	+	+	+	+
	Independently	IV	---	+	+	+	---	+	+	---
		V	---	+	+	+	---	+	+	---
		VI	+	+	+	+	+	+	+	+
Walking	With support	IV	+	+	+	+	+	+	+	
		V	+	+	+	+	+	+	+	
		VI	+	+	+	+	+	+	+	
	Independently	IV	---	+	+	+	---	+	+	---
		V	---	+	+	+	---	+	+	+
		VI	---	+	+	+	+	+	+	+
	With supporting means	IV	+	+	+	+	+	+	+	+
		V	+	+	+	+	+	+	+	+
		VI	+	+	+	+	+	+	+	+

As it has become obvious, **standing up by putting one leg forward** had no effect. As for the skill of standing up from bear’s position – this skill was improved to 75.1 percent by the end of the third stage, and to 87.5 percent by the end of the fourth stage. All the members of the group developed the skill of **standing up with support**. And the skills of **walking with supporting means** and **standing independently** were improved to 62.5 percent, after three and four years practice; after three years of exercising 62.5 percent of patients, became able to walk independently, these results were improved to 75.1 percent, after four years and to 87.5 percent by the end of five years.

Table # 7 shows the dynamics of results received during five-year’s period of medical exercises.

Table VII: Effectiveness of Treatment

Patients	Initial Stage	After 1 year	After 2 years	After 3 years	After 4 years	After 5 years
1	9.2%	12.1%	25.6%	30.9%	40.8%	56.8%
2	12.6%	20.1%	35.8%	41.8%	49.7%	58.2%
3	11.2%	19.2%	30.9%	38.5%	44.9%	56.8%
4	10.3%	18.4%	32.8%	38.4%	45.8%	57.8%
5	9.5%	11.5%	27.7%	34.2%	39.7%	48.1%
6	10.6%	19.8%	31.5%	39.9%	48.9%	56.9%
7	11.8%	18.3%	29.7%	36.8%	42.9%	52.8%
8	9.8%	15.2%	26.8%	34.8%	43.8%	50.3%

As it is seen from the Table results of physical exercises were improved to 16.8 percent in one year, to 30.1 percent in two-year period, to 36.9 percent in three-year period, to 44.5 percent in four-year period and to 54.7 percent in five-year period, in comparison with the results of the initial stage (10.6 percent).

Results of the research show significant increase of GMFm-scale points for every child that makes the effectiveness of physical exercises evident; individual data of patients are also clear and it makes it possible to correct the amount of load.

The first Chart below shows dynamics of physical exercises results. The vertical axis presents percentages and horizontal axis indicates the cases of research. There are the following markers: I – the initial stage, II – results after one year, III – results after two years IV - results after three years, V – results after four years, V – results after five years

As the chart indicates, physical exercises each individual underwent have results that are easily distinguishable from another. And this difference is in direct correlation with the severity of disease and graded physical exercises which individuals underwent during the therapeutic treatment.

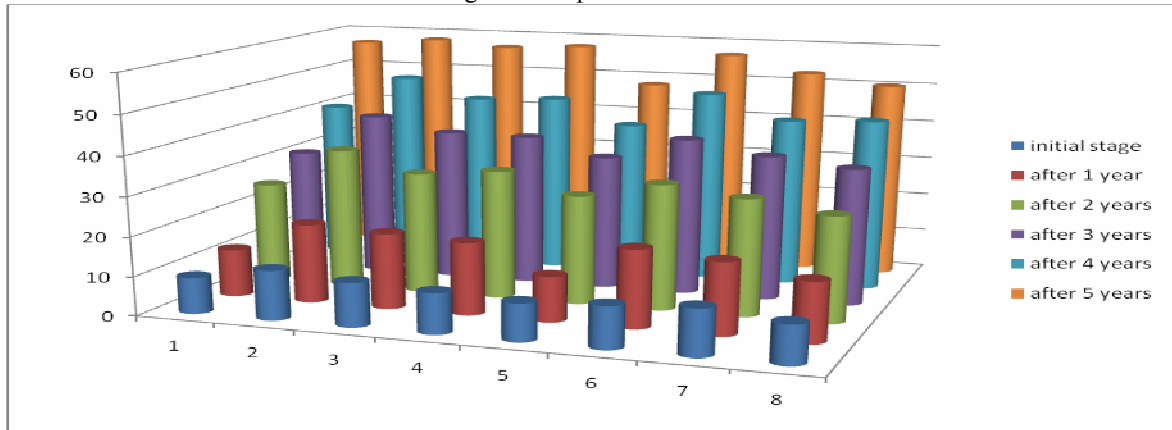


Chart 1: Treatment Results

The results of the research made it evident that regular physical therapy improves patients' motor skills and disability significantly. By decreasing the level of disability we can improve patient's quality of life, social activities, psychological and emotional climate of his or her family and reduce waste of economic resources.

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